

1922
T 75

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

BUILDING USE ONLY.

PHILOLOGICAL STUDIES IN ANCIENT GLASS

By

MARY LUELLA TROWBRIDGE

A. B. University of Illinois, 1915

A. M. University of Illinois, 1916

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY IN CLASSICS IN THE
GRADUATE SCHOOL OF THE UNIVERSITY OF
ILLINOIS, 1922

URBANA, ILLINOIS

Digitized by the Internet Archive
in 2016

https://archive.org/details/philologicalstud00trow_0

500
T75

UNIVERSITY OF ILLINOIS

THE GRADUATE SCHOOL

May 15, 1922

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY

SUPERVISION BY Mary Luella Trowbridge

ENTITLED Philological Studies in ancient Glass

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR

THE DEGREE OF Doctor of Philosophy

W. A. Dwyer

In Charge of Thesis

H. J. Barton

Head of Department

Recommendation concurred in*

Arthur Langley Bean
G. T. Olinstead
V. V. Carter

Committee

on

Final Examination*

*Required for doctor's degree but not for master's

The writer wishes to express her indebtedness to those members of the faculty of the University of Illinois whose courses she has taken. To Professor W. A. Oldfather, under whose direction this thesis was prepared, she is especially indebted; and she takes pleasure in acknowledging her obligations to both Professor W. A. Oldfather and Professor A. S. Pease for their kindly criticism and assistance.

TABLE OF CONTENTS

	Page
I. THE PURPOSE OF THIS STUDY	1- 3
II THE GREEK WORDS FOR GLASS	4-62
A. <u>Kyanos</u>	4-14
B. <u>Lithos Chytê</u>	15-18
C. <u>Hyalos</u>	19-57
D. <u>Krystallos</u>	58-61
E. <u>Morria</u>	62-63
III THE MANUFACTURE OF GLASS	64-90
A. Traditional Origin	64-65
B. Materials	66-70
C. Methods	71-73
D. Kinds of Glass	74-79
E. Glass Workers	80-83
F. Manufacturing Centers	84-87
G. Evidence for the Importance of the Trade . .	88-90

I. THE PURPOSE OF THIS STUDY

Since almost every important excavation adds something to the treasures of glass, it is not strange that archaeologists should find in the study of the objects themselves an unending source of interest. Consequently the history of glass has been admirably treated from an archaeological standpoint, most recently, for example, in the exhaustive study, Das Glas im Altertume by Anton Kisa. In the present study, therefore, there will be no use of the actual objects found, except incidentally; literary evidence alone will be considered, and that of all kinds. This, then, is a philological and historical study solely, intended to supplement from the side of written or inscriptional records the works on archaeology.

From the philological point of view the Greek words for glass will be treated;¹ from the historical both the manufacture of glass and its uses. In the first place, the purpose of this study is to take up chronologically the different Greek words by which glass was designated, such as kyanos, lithos chytê, hyalos, and krystallos, and discuss their etymology, orthography, derivatives and compounds, and meaning.

On the historical side the archaeologist can go back much farther than any one who is simply searching through written

¹I hope to discuss the Latin words for glass at another time.

records. By chemical analysis he can find out what materials were used; by an examination of actual objects he can tell how they were made; by the discovery of the glass ovens he can locate some of the chief manufacturing centers; from the amount of glass discovered, its particular variety and the place of discovery, he can draw conclusions as to the importance of the trade. The present study aims to supplement all this with what the Greeks and Romans themselves record of the manufacture of glass, of the story they tell of its origin, of the materials, where to obtain them and what proportions to use, of how to build the furnace and color and handle the molten glass, of the different kinds of glass and where they were made. And, furthermore, if it were not for literary evidence, especially the Roman law, there would not be even a glimpse of the social standing of the workmen who made these beautiful objects. From the classification of glass with precious metals, from the incidents recorded in history and from the laws, comes otherwise unobtainable evidence for the importance of the trade. Although the museums contain many glass objects not mentioned in literature, there are a few recorded in literature which are only known from that source, as, for instance, the use of glass compounded with other substances as a medicine. The different objects will be treated chronologically in the order in which they are first mentioned in literature.¹ Even if there are few

¹Of course this method of listing the uses of glass is without prejudice to the question of the relative date at which glass was actually employed for different purposes. Archaeological evidence is of prime importance to that aspect of the general problem, and literary evidence must in this respect be used with circumspection, since, strictly speaking, it affords usually only the terminus post quem.

new uses to be recorded, the incidents told about the objects may be of interest, and the date of the first recorded instance of employment for one purpose or another will have a certain degree of importance as a modest contribution to the history of material civilization. Throughout, then, in the historical part as well as in the philological, my aim is solely to supplement the study of actual monuments with literary evidence.

II. THE GREEK WORDS FOR GLASS

A. Kyanos

In Homer there is no instance of hyalos, the word by which glass was designated in later times, nevertheless glass in the form of paste or enamel was known and referred to by the term kyanos. It is mentioned in the description of the palace of Alcinous, about the bronze walls of which there ran a frieze of kyanos.¹ In the hut of Nestor there was a table with feet of kyanos.² Its use in the decoration of armor, however, seems to have been especially widespread. The breastplate of Agamemnon was inlaid with kyanos, gold and tin; the central boss of his shield was of the same material, as well as the snakes on his breastplate and baldric.³ On the shield of Achilles a ditch of kyanos ran about the vineyard.⁴ Somewhat later the author of the Shield of Herakles, a work of the Hesiodic school, speaks, probably in imitation of Homer, of 'zones' or 'concentric bands'

¹Od. 7, 87 (86): χάλκεοι μὲν γὰρ τοῖχοι ἐληλέδατ' ἐνθα καὶ ἐνθα, ἐς μυχὸν ἔξ οὐδοῦ, περὶ δὲ θρυγκὸς κυάνιο. Schol. E on Od. 7, 87: κυάνιο δὲ ὁ ἔχων τὴν βαφὴν ἀπὸ τοῦ κυάνου εἶδος βάρματος ὄντος· κύανος, κυάνεος, κυανόων, ὡς χρύσειος, χρυσοῦν· ὅστις κύανος ἐστὶ μέλας. Eust. 1570, 28: ὁ δὲ κύανος, χρώμα τι μέλαν ἔξ οὗ τὸ κυάνειον μετουσιαστικῶς, ἀφ' οὗ κυάνεον καὶ κυανόων. κυάνεος δὲ νῦν ὁ θρυγκὸς τῶ τέλει, ὡς ἂν οὕτως ἀεροκίδες τὸ μετέωρον φαίνοιτο.

²Il. 11, 629 (628): ἡ σφῶιν πρῶτον μὲν ἐπιπροΐηλε τράπεζαν | καλὴν κυανό-
πεζαν εὐρύοον. Cf. Schol. A. Eust. 867, 27: τὸ δὲ κυανόπεζαν μετὰ τοῦ τράπεζαν
ἔχει μὲν τὴν κάλλους διὰ τὸ ὁμοιοκατάληκτον· δηλοῖ δὲ οὐ μόνον τὴν ἀπὸ κυάνου ἔχουσαν
τοὺς πόδας, καθὰ καὶ ἀργυροπέδα λέγεται ἢ ἔξ ἀργύρου, ἀλλὰ καὶ τὴν ἔχουσαν κυανέαν τὴν
πέζαν, ὅ ἐστι τὸν ἔξω κύκλον, καθὰ φαίνεται οἱ παλαιοί.

³Il. 11, 24 ff.: τοῦ δ' ἦ τοι δέκαθ' οἱ ἔσαν μέλανος κυάνιοι, | δώδεκα δὲ χρυσοῖο καὶ
ἐλκοῖ κασιτέροιο | κυάνεοι δὲ δράκοντες ὀφρῶρχατο προτὶ δειρὴν | τρεῖς ἐκάτερθ'... ἐν δὲ οἱ
ὀμφαλοὶ ἦσαν ἐλκοῖ κασιτέροιο | λευκοί, ἐν δὲ μέσοισιν ἔην μέλανος κυάνιοι... τῆς δ' ἔξ
ἀργύρεος τελαμῶν ἦν· αὐτὰρ ἐπ' αὐτοῦ | κυάνεος ἐλάληκτο δράκων. Eust. 828, 20: κύανος
δὲ εἶδος τι χρώματος μέλανος, ἔξ οὗ τὸ κυάνειον, καὶ ὑφαίρεται τοῦ δειχρόνου κυάνεον, καὶ
ἐν συναίρεσει κυανόων. Cf. Schol. BL on Il. 11, 24.

⁴Il. 18, 564: ἀμφὶ δὲ κυανὴν κάπետον.

of kyanos upon the shield of that hero.¹

From the early poets no idea of the nature of this substance can be obtained, but something can be learned concerning its color and appearance. Homer calls the kyanos on the armor melas, 'black', which probably means no more than 'dark'. As an adjective or in compounds he uses it to refer to the hair,² the beard,³ the brow,⁴ the eyes,⁵ the clouds,⁶ the phalanx,⁷ the prows of ships,⁸ the sand of Charybdis,⁹ and the robe of Thetis.¹⁰ When the hair of Poseidon is mentioned, it would not seem altogether inappropriate to consider it as resembling the dark blue of the sea.¹¹ The eyes also of Amphitrite would doubtless be blue; but

¹Hes. Sc. 143: κυάνου δὲ διὰ πτύχες ἡλήλαντο.

²Il. 22, 402 (401): ἄρφ' ὅς τε χαῖται | κυάνεαι πίτναντο. Cf. Eust. 1276, 26. Usually as an epithet of Poseidon, Il. 13, 563 (562): ἄμειν ἤνωσεν δὲ οἱ αἰχρῆν | κυανοχάσται Ποσειδάων, ριότοιο μεγέρας. Cf. Il. 14, 390; 15, 174, 201; 20, 144; Od. 3, 6; 9, 528, 536. Of a horse, Il. 20, 224.

³Od. 16, 176: κυάνεαι δ' ἐγένοντο γενεάσδεσ ἀρφὶ γένειον. Cf. Eust. 1798, 63; 1799, 19, 25.

⁴Il. 1, 528, Of Zeus: ἦ καὶ κυανέησιν ἐπ' ὀφρύσι νεῦσε Κρονίων. Schol. Blv: κυάνεαι δὲ αἱ μέλαιναι καὶ αἱ καταπλήκτικαί. Cf. Il. 17, 209. Of Hera, Il. 15, 102. Cf. Eust. 1008, 2ff.

⁵Od. 12, 60 (59), of Amphitrite: προτὶ δ' αὐτὰς | κύμα μέγα ῥοχθεῖ | κυανώπιδος Ἀμφιτρίτης.

⁶Il. 5, 345 (344): καὶ τὸν μὲν μετὰ χερσὶν ἐρύσατο Φοῖβος Ἀπόλλων | κυανέη νεφέλη. Il. 16, 66. Cf. Eust. 1046, 9. Il. 20, 418; 23, 188. Cf. Eust. 1295, 34. Od. 12, 75. Cf. Eust. 1714, 5. Od. 12, 405; 14, 303.

⁷Il. 4, 282 (280): τοῖσι ἄρ' Αἰάντεσσι διοτρεφέων αἰχμηῶν | δῆιον ἐς πόδεσσιν | πυκινὰ κένοντο φάλαγγες | κυάνεαι.

⁸Il. 15, 693 ff.: ὣς ἔκτωρ ἵθυσεν νεὸς κυανοπρώροιο | ἀντίος Ἀίγας. Cf. Il. 23, 852, 878; Od. 3, 299; 9, 482, 539; 11, 6; 12, 100, 148, 354; 14, 311; 22, 465.

⁹Od. 12, 243 (242): ὑπένερχε δὲ γαῖα φάνεσκε | φάρμ' ἢ κυανέη.

¹⁰Il. 24, 94 (93): ὥς ἄρα φωνήσασα κάλυμ' ἔλε δὲ θεῶν | κυάνεον, τοῦ δ' ὅτε μελάντερον ἔπλετο ἔσθος.

¹¹Of course, sea-green, is also possible, but hair is seldom, if ever, greenish in appearance, and the southern seas, unlike these of the north, are predominantly blue, not green, in color.

in none of the other instances is there any suggestion of blueness. Some of them could be black, but all of the references convey at least the idea of darkness.¹ What then was this dark material used upon wall, shields, and table?

Theophrastus is the first to say anything about the nature of the substance. "Kyanos too," he writes, "is both natural and artificial, as in Egypt. There are three kinds of kyanos, the Egyptian, the Scythian, and third, the Cyprian. The Egyptian is best for the darker colors, the Scythian for the lighter."² The Egyptian is artificial. And those who write about the kings also record which king first melted kyanos so as to imitate the natural, and that when gifts are being sent by some from Phoenicia there is sent a tribute of kyanos, both unfired and burnt. And those who grind the pigments say that kyanos of itself makes four colors, the first lighter from the thinner parts, and the other darker from the thicker."³ As for the natural kyanos he speaks of two kinds, a lighter and a darker,⁴ from the color of which the sapphire is not far distant.⁵ It is

¹The scholiasts on Homer and Eustathius had the feeling that kyanos was melas. In Greek literature kyanos and melas are applied to the same things, as the aegis, horses, hair, eyes, water, ships, and the like. See Ebeling, Lex. Homer. 1, 920 ff.

²Literally, "The Egyptian is best for the pure pigments; the Scythian for the weaker."

³Theophr. de Lap. 55: καὶ κύανος ὁ μὲν αὐτοφυὴς ὁ δὲ σκευαστὸς ὥσπερ ἐν Αἰγύπτῳ. γένη δὲ κυάνου τρία, ὁ αἰγύπτιος, καὶ σκύθης, καὶ τρίτος ὁ κύπριος. βέλτιστος δ' ὁ αἰγύπτιος εἰς τὰ ἄκρατα λειώματα, ὁ δὲ σκύθης εἰς τὰ ὑδαρέστερα, ὁ δὲ κύπριος δ' ὁ αἰγύπτιος. καὶ οἱ γράφοντες τὰ περὶ τοὺς βασιλεῖς καὶ τοῦτο γράφουσι, τίς πρῶτος βασιλεὺς ἐποίησε χυτὸν κύανον κρηττάμενος τὸν αὐτοφυῆ, διὸ τὰ πέμπεσθαι παρ' ἄλλων τε καὶ ἐκ Φοινίκης φόρον κυάνου, τοῦ μὲν ἀπύρου τοῦ δὲ πεπυρωμένου. φασὶ δὲ οἱ τὰ φάρμακα τρίβοντες τὸν μὲν κύανον ἐξ ἑαυτοῦ ποιεῖν χρώματα τέτταρα, τὸ μὲν πρῶτον ἐκ τῶν λεπτωτάτων λεπτότατον, τὸ δὲ δεύτερον ἐκ παχυτάτων μελάντατον.

⁴Ibid. 31: καλεῖται δὲ καὶ κύανος ὁ μὲν ἄρην ὁ δὲ θῆλυς· μελάντερος δὲ ὁ ἄρην.

⁵Ibid. 37: καὶ ἦν καλοῦσι σάπφειρον· αὕτη γὰρ μέλαινα οὐκ ἔχεν πόρρω τοῦ κυάνου τοῦ ἄρηνος καὶ πρασίτις.

found among metals¹ and contains a trace of a golden color,² which would give it a glistening appearance. Dioscorides mentions only the kyanos of Cyprus.³ Theophrastus is followed more or less accurately by Pliny in his Natural History, where in one place he uses caeruleum⁴ for kyanos and in another the transliterated form, cyanos.⁵ He adds little except that in his own day there was a preference for the caeruleum of Cyprus.⁶

Theophrastus had to be interpreted before his description could throw any light on the kyanos of the early poets. It was not until Lepsius⁷ by an interpretation of the Egyptian inscriptions and by chemical analysis identified the three kinds, that its nature was understood. This view of Lepsius was accepted and further developed by Helbig.⁸ They identified the natural

¹Ibid. 51: εὐρίσκεται δὴ πάντα ἐν τοῖς μετάλλοις τοῖς ἀργυρεοῖς τε καὶ χρυσεοῖς, ἐνὶ δὲ καὶ ἐν τοῖς χαλκορυχείοις, οἷον ἄρρενικόν, σανδαράκη, χρυσοκόλλα, μίλτος, ὦχρα, κύανος· ἐλάχιστος δὲ οὗτος καὶ κατ' ἐλάχιστα.

²Ibid. 39: καὶ κύανος αὐτοφυῆς ἔχων ἐν ἑαυτῷ χρυσοκόλλαν.

³Diosc. 5, 106: κυανὸς δὲ γεννᾶται μὲν ἐν Κύπρῳ ἐκ τῶν χαλκουργῶν μετάλλων· ὁ δὲ πλείων ἐκ τῆς αἰγιαλίτιδος ἄρρου, εὐρισκόμενος κατὰ τινὰς σπηλαιώδεις ὑποσκαφὰς τῆς θαλάσσης, ἥτις καὶ διαφέρει.

⁴N. H. 33, 161: caeruleum harena est huius genera tria fuere antiquitus: Aegyptium maxime probatur; Scythicum mox diluitur facile et, cum teritur, in quattuor colores mutatur, candidiorem nigrioremve et crassiorem tenuioremve; praefertur huic etiamnum Cyprium.

⁵Ibid. 37, 119: reddetur et per se cyanos; accommodato paulo ante et iaspidi nomine a colore caeruleo. optima Scythica, dein Cypria, postremo Aegyptia. adulteratur maxime tinctura, idque in gloria est regum Aegypti; adscribitur et qui primus tinxit. dividitur autem et haec in mares feminasque. in-est ei aliquando et aureus pulvis, non qualis sappiris; in his enim aurum punctis conluet.

⁶By caeruleum the Romans understood a kind of pigment. See Blumner, Tech. u. Term., 4, 499 ff.; Thes. Ling. Lat. 3, 107.

⁷Die Metalle in den ägypt. Inschriften (Abhandl. d. Berl. Akad. 1871, 69-79, 130 ff.)

⁸Das homer. Epos, ed. 2, 100 ff.

kyanos of Scythia with lapis lazuli and the color obtained from it; the kyanos of Cyprus, the caeruleum Cyprium of Pliny, with the blue pigment found in crystals or in the earth near copper-beds, that is, azurite, a form of copper ore; the artificial kyanos of Egypt with glass-paste resembling the others in color. Since Cyprus, which was noted for its copper, was under Phoenician control for a long time, the unfired kyanos taken by them to the Egyptian king was identified with the azurite from the copper-beds. The next step was to conjecture that the kyanos of Homer's palace was an artificial blue glass-paste,¹ and this view was confirmed by the discovery of just such a frieze at Tiryns.² The decoration on the shields would naturally be of the same material. Since Cyprus was noted for its kyanos, it may be of some significance that the breastplate of Agememnon was a gift from Cinyras, king of that island.³

As a substantive kyanos does not occur frequently in later literature and when it does, it is often clearly a reminiscence of Homer. Plato⁴ describes the Styx as having a color like that of kyanos. Eratosthenes'⁵ mention of "zones darker than shining kyanos" brings to mind at once the inlaid work on the

¹Ibid. 106.

²H. Schliemann, Tiryns, 284 ff.; Baumeister, Denkmäler, 3, Taf. 77; J. Van Leeuwen et M. Mendes da Costa, Homeri Od. Carm. on 7, 87; C. Schuchhardt, Schliemann's Excavations, 141 (Trans. by E. Sellers, 116); G. Finsler, Homer, 296; P. Kavvadias, Προϊστορική Αρχαιολογία, 193; E. Drerup, Homer, ed. 2, 51; Hall, Aeg. Arch., 198; 204.

³Il. 11, 21ff.; πεύθετο γὰρ Κύπρονδε μέγα κλέος, οὐνεκ' Ἀχαιοὶ ἰὲς Τροίην νηέσσιν ἀναπλεύσεσθαι ἔμελλον· τούνεκά οἱ τὸν ἔδωκε χαρίζομενος βασιλῆς.

⁴Phaedo, 113 B ff.; τούτου δὲ αὖ καταντικρὺ δὲ τέταρτος ἐκπίπτει εἰς τόπον πρῶτον δεινόν τε καὶ ἄγριον, ὡς λέγεται, χρωρὰ δ' ἔχοντα ὅλον ὄλον δὲ κυανός, δὲ δὴ ἐπονομάζουσι Στύγιον.

⁵Achill. Tat. Isag. (Patr. Gr. 19, 980 c): Ἐρατοσθένους ἐν τῷ Ἑρτῇ λέγων πάντες δὲ αἱ ζῶναι περὶ κλέος ἐσπεύρηνται· αἱ δὲ οὐκ ἔχουσιν γλαυκὸν καὶ λευκότερον κυανόν.

Homeric shields. When kyanos was used for the adornment of surfaces, at first glass-paste was meant, later a kind of paint. The latter would present a shining appearance and when applied to a quill,¹ it is spoken of as porphyryon, 'dark'. It was also used for painting walls² and little toy figures or idols.³ In the field of natural history kyanos is the name of a bird⁴ and of plants,⁵ applied no doubt because of their color.

If the glass-paste and azurite were called kyanos from their resemblance to lapis lazuli, the chief characteristic of kyanos would seem to be that of blueness. There is no reason to doubt that the kyanos of the poets was of that color. However, it is difficult to understand why the later use of the substantive and its derivatives and compounds does not convey solely that idea.⁶

¹Crinagoras (Anth. Pal. 6, 329): Αἰετοῦ ἀγκυλοχείλου ἀκρόπτερον
ὃς δὲ σιδήρεϊ γλυφθέν, καὶ βαπτῇ πορφύρεον κυάνῳ.

²Paus. 5, 11, 5: τούτων τῶν ἐρυμάτων ὅσον μὲν ἀπαντικρὺ τῶν
θυρῶν ἐστίν, ἀλήλιπται κυανῷ μόνον.

³Luc. Lexiph. 22: ὥς νῦν γε ἐλελήθεις σαυτὸν τοῖς ὑπὸ τῶν
κοροπλάθων ἐς τὴν ἀγορὰν πλαττομένοις ἑοικώς, κεχρωσμένος
μὲν τῇ μίλτῳ καὶ τῷ κυανῷ, τὸ δ' ἐνδοθεν πῆλινος τε καὶ εὐθρυπτος ὢν.

⁴Arist. H. A. 9, 18, 21: ἔστι δέ τις πετραῖος ᾧ ὄνομα κύανος· οὗτος
ὁ ὄρνις ἐν Νισύρῳ μάλιστα ἐστίν, ποιεῖται δ' ἐπὶ τῶν πετρῶν τὰς
διατρίβας. τὸ δὲ μέγεθος κοττύρου μὲν ἐλάττω, σπίνης δὲ μείζων
μικρῷ. μελανόπους δὲ, καὶ πρὸς τὰς πέτρας προσαναβαίνει.
κυανοῦς δ' ὅλος· τὸ δὲ εὐχλος ἔχει λεπτόν καὶ μακρόν, σκέλη δὲ
βραχέα τῇ πηλοῖ παρόμοια. According to Thompson, A Gloss. of Gr.
Birds, 103 ff., this was probably the wall-creeper, Tichodroma,
Muraria, L.

⁵Meleager (Anth. Pal. 4, 1, 39 ff.): τοῖς δ' ἄρ' Αλεξάνδρου νεοῦς ὀρνίθας
ἐλάϊς, ἥ δὲ Πολυκλείτου πορφυρέην κύανον. Plin. N.H. 21, 68: in Italia
violis succedit rosa, huic intervenit lilium, rosam cyanus excipit,
cyanum aurarantus. The name is at present applied to Centaurea
Cyanus, L. - the bachelor's button.

⁶Compare in Latin the similar use of caeruleus, which is sometimes
'blue,' sometimes 'dark,' sometimes 'gleaming.' See the articles on
caeruleus and cyaneus in Thes. Ling. Lat.

That these do not is clear from their use even by Homer, as well as in later writers. A few scattered references will serve to show the divergence of feeling concerning its color.

Although the outstanding characteristic of the derivatives of kyanos in Homer is darkness, in nearly every instance they are applied to something that glistens. The snakes of kyanos are even compared with rainbows¹ because of their bright, iridescent appearance. When Callimachus² uses kyaneos to describe pitch, he certainly thinks of it as black, but black and shining. Aristotle³ mentions kyaneos and melas side by side as if they were a little different. It probably means blue in Philostratus'⁴ description of the peacock fish, which is so named from its color, for the striking characteristic of the peacock's feather is the remarkable eye shaped patch of brilliant blue; but the quality of iridescence might also have been in mind, for the peacock's feathers have that quality too, as does pitch, with which, as we have just seen, Callimachus compares kyanos. The same divergence

¹Il. 11, 26 ff.: ΚΥΑΝΕΟΙ δὲ ΔΡΑΚΟΝΤΕΣ ὀρωρέχοντο προτὶ δειρὴν ἰτρεῖς ἐκάτερθε ἴρισιν ἑοικότες. As a further development of this idea the rainbow itself is called kyanê. Cf. Dio Chrysost. Orat. 12, 414 R: ἡ τανύοντα κυανῆν ἴριν.

²Hekale, Col. 4, 49: ΚΥΑΝΕΟΝ φηὶ πίσσαν.

³Meteor. 15, 342 a, 34 ff.: τοῦ φωτὸς ἐκ κυανέου καὶ μέλανος. In drawing up a long list of the colors of painters Pollux also speaks of kyanos and black but not of blue, so kyanos almost certainly stands for dark blue here. 7, 29: τὰ δὲ χρώματα, ἃν δρεῖκελον, ὄστρεον, πρασινόν, κροκοειδές, κυανόον, κιννάβαρι, ξανθόν, φαιόν, φλογόλευκον, λευκόφαιον, λευκόν, μέλαν, μέλαμβας, φές. Apion, however, considers it the same as melas. Etym. Gud.: ΚΥΑΝΕΟΝ τὸ χρώμα καὶ τὸ μέλαν. Cf. Ludwig in Philologus, N.S. 28, 245.

⁴Vita Ap. 1, 85: καὶ τοὺς ἰχθύς τοὺς ταύς, οὓς οὗτος μόνος ποταμῶν τρέφει, πεποιήνται δὲ αὐτοὺς ὀρωνύμους τοῦ ὀρνίθου, ἑπεὶ ΚΥΑΝΕΟΙ μὲν αὐτοὺς οἱ λόφοι, στικταὶ δὲ αἱ φολίδες, χρυσὰ δὲ τὰ οὐράτα καὶ, δπότε θούλονται, ἀνακλώμενα. On the color of the peacock cf. Dio Chrysostum, Oratio, 12, 11.

in color is found among the compounds of kyanos. Pallas is called "She of the kyanos aegis."¹ The son of Aegialeus, the Argive, is Kyanippos, 'Black-horse'.² When kyanos is used of water, the idea suggested is probably dark-blue gleaming where the reference is to the sea, but more likely nearly dark, or dark-gleaming, when used of fresh water.³ The vault of the heavens⁴ is probably thought of as blue, or possibly as gleaming, without reference to the exact hue.

In a study of glass it is impossible to consider in greater detail the later development of kyanos, its derivatives and compounds,⁵ but a brief summary may be made from the lexicographers and etymologists of the fifth to the thirteenth centuries. In Hesychius the chief idea is that of darkness, if not of blackness, but he gives some instances where kyanos might be or is used to indicate blueness, as the color of the heaven.⁶ The same might

¹Pind. Ol. 13, 100 ff.: κυάναυγίς ἐν ὄρεσσι κνώσσοντί οἱ παρθένος τόσα εἰπεῖν ἔδοξεν. Since the aegis was originally a goatskin, and every Greek must have felt that as he used the word, kyanos here can hardly mean anything but 'black' or 'dark'.

²Paus. 2, 18, 4: ἀπὸ μὲν δὴ βίαντος βασιλεύουσι πάντε ἄνδρες ἐπὶ γενεᾷς τέσσαρας ἐς Κυάνιππον τὸν Αἰγιάλεως.

³Phryn. Praep. Soph. 78, 1 ff.: κυαναυγὴς θάλαττα, καὶ κυαναυγὲς ὕδωρ, καὶ κυαναυγὴς ποταμός. Cf. In a diptych from Cairo (B.C.H. 28, 208): κυανωπὸν ὕδωρ. Compare Homer's 'dark water' (μέλαν ὕδωρ) used of the water of springs and rivers, on which see Ebeling, Lex. Homer. 1, 1038, col. 2, and the rivers called Melas, no fewer than ten in number, see Pape-Benseler, Wörterb. d. griech. Eigennamen, s. v. (in modern Greece also the Kephissos in Phokis is called Mauropotamos, 'Blackriver').

⁴Synes. Hymn. 9, 45: σὺ δὲ τὰρσὸν ἐλάσσης, | κυανάν τυγος οὐρανοῦ | ὑπὲρ ἡλίου νύκτων, | σφαίρησι δ' ἐπετάσθης | νοεραῖσιν ἀκηράτοις | ἄγαθων ὄντων παγὰ, | σιγῶμενος οὐρανός.

⁵For further references see the articles on κύανος its derivatives and compounds in Pape-Benseler, op. cit.; Roscher, Ausführ. Lex. der gr. u. rom. Myth.; Thes. Gr. Ling. s. v. κύανος (κυανός).

⁶Lex.: κυανέη· μελαίνη· φαῖν | κυανέησι· φαίσις· μελαναῖς | κυάνεος· μέλας· σκοτεινός· ἐλεγκτοδράκων μέλας ἐν τῷ ἀναφορεῖ (H52. 92-528) | κυανέων· Μαύρων, Αἰθιοπῶν | κυανόν· εἶδος χρώματος οὐρανοειδές | κυανόπεγα· μελανόπους | κυανός· θαλάττιον ὕδωρ καὶ ὄρεσι | κυανοχίτης· μελανόβριξ· Ποσειδῶν· ε. x. ὑπερκυάνεον· λίαν κυάνεον.

be said of Photius¹ and the Anecdota edited by Bachmann.² In the latter, however, there is an exception, glaukos is defined as 'white, kyaneos'.³ This definition is repeated in Suidas,⁴ the Etymologicum Gudianum⁵ and Zonaras.⁶ In none of the instances considered has there been any suggestion of whiteness but just the opposite, and Philoponus rightly lists kyanos among the colors more closely akin to black.⁷ Reference, however, has been made frequently to the gleaming of kyanos and it is very probable that at times it suggested simply something bright and shining. However, it may be but a definition of light-blue, light blue and glistening perhaps, for Plato says that a combination of kyanos and leukos produces glaukos.⁸ It is to be observed that kyanos (or kyaneos) is used merely as a gloss for glaukos, not for leukos, galakti eoikôs, or the like, for in lexicographical definitions or synonyms, one cannot safely proceed upon the principle that things which are equal to the same thing are equal to each other, since it is not precisely 'the same thing' for which

¹ Phot. Lex. (ed. Porson): κυανέοι· μέλανες | κυανοχαίτης· μελάνθριξ· πορφυρόθριξ· ποσειδῶν | ξαρδόκιος γέλως... ἐπ' ὀφρύσι κυανέητιν.

² Anec. Gr. 1, 284, 8: κυανέοι· μέλανες. 284, 10: κυανοχαίτης· μελάνθριξ· πορφυρόθριξ· ποσειδῶν.

³ Ibid. 185, 12: γλαυκός· λευκός, κυάνεος. Cf. Hesych.

⁴ Suid. s. v. γλαυκός· λευκός, κυάνεος.

⁵ Etym. Gud. (ed. Sturz, 126, 3): γλαυκός, λευκός, κυανός, γάλακτι εοικώς τὴν σάρκα καὶ τὰ ὄρματα.

⁶ Lex. 438: γλαυκός· κυανός, ἢ λευκός, ἢ πυρώδη τὰ ὄρματα ἔχων.

⁷ On Aristotle's de Anima, 2, 406, 29: τὰ δὲ ἐγγυτέρω τοῦ μέλανος, ὡς τὸ κυανόν.

⁸ Tim. 68c: λαμπρῷ δὲ λευκὸν συνελθόν καὶ εἰς μέλαν κατακορῆς ἐμπεσόν κυανόν· χρῶμα ἀποτελεῖται, κυανοῦ δὲ λευκῷ κεραννυμένου γλαυκόν, πυρροῦ δὲ μέλανι πράσιον.

the several glosses are proposed. Glaukos clearly meant, 'blue-bright', 'gray-blue-bright', and it is probable that the gloss kyaneos may have arisen from the application of glaukos in some poetical passage to an object that was commonly called kyaneos, or vice versa, from which the glossographer's deduction, that these words are occasionally used as roughly equivalent to one another, would be justified. Such objects would be the sea, water in general, eyes, hair or mane (to all of which glaukos and kyaneos are actually applied). Zonaras¹ also gives the ordinary meanings for kyanos, as well as the Etymologicum Magnum.² It may be because of the deep shade of kyanos, which was called melas even in Homer and Theophrastus, that the idea of blueness gave way almost entirely to that of darkness. Or the original meaning may have been simply the dark-gleaming, which would be applicable to lapis lazuli because of its dark, glistening appearance (compare the passage quoted above where Callimachus compares kyanos to pitch).

When there is such a divergence among ancient writers in their conception of the nature and color of kyanos, it is not strange that modern scholars should be puzzled by the word. The attempt to compare it with the Sanscrit çjā-mā-s, 'black', has

¹Lex. 1262: κυανοχαίτης, μελανόθριξ. κυανόν γάρ τὸ μέλαν, καὶ χαίτη ἢ θρίξ. 1268: κυανόν. τὸ μέλαν.

²542, 48: κυανός· ἐκ τοῦ κῦρα γίνεται κυανός· καὶ ἀποβολὴ τοῦ Μ, κυανός, ὁ μέλας· κυάνειος, καὶ κυάνεος· καὶ κυανέα τῆς κυανέας. 641, 28: ψάμμω κυανέῃ ἀντὶ τοῦ κυανίζουσα. 692, 32: κυανοπρωίρους· καὶ παρὰ Σιμωνίδῃ, κυανοπρωίραν. 718, 33... ἕως τοῦ στομίου τοῦ Πόντου, ἔνθα εἰσὶν καὶ αἱ κυανεαὶ πέτραι.

been abandoned¹ and as yet the etymology is unknown.²

To summarize, then, it seems pretty certain that glass-paste was first called kyanos from its similarity to some natural stone or mineral. When actual glass in the common meaning of the term became better known, it was designated by new terms, because, no doubt, it was thought to be a different substance from kyanos. But the word by which glass-paste was originally known, went on developing new compounds and new derivatives which seldom, if ever, give any suggestion of material but rather of color, sometimes blue, sometimes black, usually simply the idea dark, glistening, iridescent, or dark-gleaming. This last may very well have been the original idea from which the others developed in two direction, one emphasizing the idea of darkness, the other that of glistening or gleaming.

¹Benfey in G. Curtius, Gr. Etym. ed. 5, 546; 612.

²E. Boisacq, Dict. Etym. de la Lang. Grec. 527.

B. Lithos Chytê

For a long time the Greeks had no special word to designate glass in general. Although kyanos stood for a form of glass-paste, from the literary evidence there is no indication that it was applied except when the glass-paste was used in the adornment of surfaces. Very soon other uses for glass must have become familiar from imported wares and from the stories of travelers. A name was needed for new objects differing in form and color from the early kyanos. Herodotus speaks of the material of which they were made as 'molten stone,' lithos chytê.¹ It is difficult to say whether this name was applied to glass because it was formed from melted silicates or because after a process of melting, a product resembling precious stones or crystals resulted, but more probably the latter, since the silicates used were generally in the form of sand, which the Greeks would scarcely have called stone.

Since kyanos was first imitated in Egypt, it is quite appropriate that the first use of lithos chytê should be in connection with that country. Herodotus² says that about Thebes and Lake Moeris the people had sacred crocodiles which they adorned with earrings of glass and gold. The use of glass to imitate gems would be one of the simplest. Since hyalos occurs side by side with lithos chytê, the latter may have stood for some special variety. Possibly Plato³ is thinking both of glass and of some

¹W. Froehner, La Verrerie Antique, 4, thinks that Herodotus probably translated an Egyptian expression.

²2, 69: ἐκ πάντων δὲ ἓνα ἑκάτεροι τρέφουσι κροκόδειλον δεδωγμένον εἶναι χειροῦθεα, ἀρτήματα τε λίθινα χυτὰ καὶ χρύσεια ἐς τὰ ὤτα ἐνθέντες.

³Tim. 61 B: τὰ μὲν ἑλαττον ἔχοντα ὕδατος ἢ γῆς τό τε περὶ τὴν ὕαλον γένος ἅπαν ὅσα τε λίθων χυτὰ εἶδη καλεῖται.

particular form of it, such as paste gems, when he uses the expression, "all the kinds of stones that are called molten," listing them together as having less water than earth, among the things subject to the liquifying effect of fire. Although this expression does not occur frequently in literature, it must have been fairly well established, for the last mention of it occurs over two centuries after the first. Perhaps Epinicus¹ considered a goblet of 'molten stone' more suitable for poetry than one of hyalos, which was certainly a more common term by his time.

Sometimes glass was called simply lithos (fem.), 'stone.' That appellation may have arisen later as an abbreviation of lithos chytê, or simply like the longer expression because of the resemblance of glass to natural substances of a vitreous appearance. In Aristophanes' Clouds² Strepsiades asks of Socrates, "Have you ever seen at the druggists' that stone, the beautiful, the transparent one, by which they kindle fire?" Socrates queries, "You speak of the hyalos?" To be sure, the nature of glass was not very well understood as yet, and hyalos, by which it was later universally known, was sometimes applied to other transparent substances. However, there is no particular reason to think that the burning-glass was of crystal³ here. To be sure, it is called a

¹Apud Athen. 10, 432 C: γέροντα Θάσιον τὸν τε γῆς ἀπ' Ἀτθίδος ἱερὸν μελίσσης τῆς ἀκράχολου γλυκύν/συγκυρκανήσας ἐν σκύφῳ χυτῆς λίθου.

²Nub. 766ff.: ΣΤΡ. ἤδη παρὰ τοῖσι φαρμακωπώλαις τὴν λίθον/ταύτην ἑώρακας, τὴν καλὴν, τὴν διαφανῆ, ἵαφ' ἧς τὸ πῦρ ἄπτουσι; ΣΩΚ. τὴν ὑάλον λέγεις; F. H. Blaydes, Aristophanis Nubes, 101, n.767, has emended καλὴν to χυτὴν without any substantial justification.

³To be sure there is a gloss on v.766 in R and V: τὴν λίθον τὸν κρύσταλλον, but this is ambiguous for κρύσταλλος seems occasionally to have been used for glass (see below; among the Romans crystallum must often mean nothing more than glass, see Blumner, Tech. u. Term. 4, 386),

stone,¹ but that does not suggest a crystal any more than it does the other name for glass. In the Periplus of Scylax² the Phoenicians are described as taking the 'Egyptian stone' to the West Africans. From the first the Greeks seemed to connect the manufacture of glass with Egypt, and it is not surprising that it should be called simply the 'Egyptian stone.' Gems and other trifles of glass would be most profitable for trade among less civilized peoples.³ Four centuries later, in the Periplus of the Red Sea the Egyptians are spoken of as exporting to the Berbers many kinds of lithia hyalê⁴ made at Diospolis. In one instance they are called simply lithia.⁵ From the diminutive form doubtless the nature of the articles of trade is indicated. Probably there is a reference to the making of glass in Bekker's Lexica,⁶ where he

while the more elaborate scholia in R and V on v. 768 speaks unequivocally of glass, and with this view the opinion of modern scholars agrees, see Blumner, op. cit. 4, 383,4; Kisa, op. cit. 1, 166.

¹Salmas. Plin. Exercit. 773 b A: Nec impedimento est quod λίθον vocat. Auctores passim vitrum sic appellant. Auctor perippei λιθίαν ὑαλὴν ubique vocat. Quae alibi eidem dicitur ὑέλως ἀργή... Inde et κρύσταλλος glacies, quam vocem pro vitro etiam quidam usurparunt.

²Scyl. Peripl. 112 (C. Müller, Geog. Gr. Min. 1): οἱ δὲ Φοίνικες ἔμποροι εἰσάγουσιν αὐτοῖς μύρον, λίθον Αἰγυπτίαν, ἄπρους ἑφαράκτους, κέραρον Ἀττικὸν καὶ χούς.

³Blümner, Tech. u. Term. 4, 381 ff.

⁴Peripl. Maris Erythr. 6 (ed. Fabricius): προχωρεῖ δ' εἰς τοὺς τόπους ἑμάτια βαρβαρικά ἄγναφα τὰ ἐν Αἰγύπτῳ γινόμενα... καὶ λιθίας ὑαλῆς πλείονα γένη καὶ ἄλλης μουρρίνης τῆς γινόμενης ἐν Διοσπόλει. Ἰ: προχωρεῖ δ' εἰς αὐτὴν ὑαλῇ λιθία σύμμικτος. 17: καὶ λιθίας ὑαλῆς πλείονα γένη.

⁵Ibid. 10: προχωρεῖ δ' εἰς αὐτὸ τὰ προειρημένα γένη καὶ σκεύη ἀργυρᾶ, σιδηρᾶ δ' ἐλάσσονα, καὶ λιθία.

⁶5, 270: Κάμινος: τὸ κατασκευάσμα, ὅπου ὀπτᾶται ὁ κέραρος καὶ λίθος.

calls an oven "a contrivance in which earthenware and stone (lithos) are baked."

Sometimes lithos chytê is said to be an older name for hyalos.¹ It is not mentioned before Herodotus who also speaks of hyalos, although he could not have used the latter of actual glass. Before this time, however, Corinna used the adjectival form of hyalos and very soon the word occurs with the meaning 'glass.' It is true that lithos chytê is applied to glass later than hyalos, but the two words are used at the same time and occur side by side. The real reason for thinking that lithos chytê is the older expression is that it is a primitive, descriptive term, while hyalos is a shorter, more direct technical expression. Probably the Greeks were at first most familiar with glass in the form of small objects, like gems, beads and other trifles which are so easily exported. It is possible that, when glass became more common, hyalos expanded to embrace all of its forms and varieties while lithos chytê was still generally applied to the small objects for which it first stood, and in the shorter form of lithos or lithia it continued to be used for these articles of barter. Yet the case of the goblet shows that it too had broadened its meaning somewhat. In literature, however, there was never a time when lithos chytê was as common as hyalos, to which it eventually gave way entirely.²

¹A. Kisa, Das Glas im Altert. 164.

² ὁ λίθος or ὁ λίθος χυτῆ as a designation for glass probably passed out of general use soon after the introduction of a technical term which was not so liable to ambiguity, for ὁ λίθος was commonly employed to denote precious stones in general and in particular often means 'the magnet' (ὁ λίθος, sc. Μαγνήτης).

C. Hyalos

1. Etymology.-- With the introduction of transparent glass there came a new designation, hyalos, the origin of which is unknown. It is derived from hyein, 'to rain,' by the Greek lexicographers and etymologists.¹ Salmasius notes this derivation and considers that hyalos with the meaning 'wet' would be used in the sense of 'bright,' 'clear,' since objects which are wet are bright and shiny.² Some modern etymologists consider the derivation from hyein probable,³ notably Curtius, who says that "the substantive probably meant properly 'rain-drop'." Froehner thinks that it is more probably from hals, 'salt,' the upsilon standing for an old digamma.⁴ Blümner thinks that it was a foreign

¹Orion (ed. Sturz): ὑάλη· ὑάλος, παρὰ τὸ ὑεῖν ἐσχημάτισται, καθ' ὁμοιότητα τῆς γινομένης συστάσεως, καὶ πήξεως τοῦ ὕδατος, ὑάλω ὁμοίως. Ἡρακλείδης.

Etym. Gud. 538, omits the last word. Zonar. Lex. 1760: παρὰ τὸ ὑεῖν καὶ καθ' ὁμοιότητα εἶναι τῆς γινομένης συστάσεως καὶ πήξεως (μίξεως DK) τοῦ ὕδατος. Etym. Magn. 774: ὑάλος... ἐτυμολογεῖται δὲ παρὰ τὸ ὑεῖν... ὁμοίως. Miller, Melanges, 290: ὑάλος... παρὰ τὸ ὑεῖν καθ' ὁμοιότητα, κτλ.

²Salmas, Plin. Exercit. 771 a, F: Graecis ὑεῖν est madidare, et humectare, ῥέχειν, ὑγραίνειν. Inde ὑάλον, humectum. Sed et quae madidata sunt et aqua aspersa, ea lucent nitentque, ex eo factum, ut etiam ὑάλον pro lucido sumeretur. Hesych. ὑάλον λαμπρόν etc. Postea proprium hoc nomen factum vitri.

³Sonne (Kühns Zeitschr. 12, 359). Curtius, Gr. Etym. ed. 5, 604 (Trans. by A. Wilkins and E. England): "Root ὑ-εῖ it rains, ὑ-ε-τό-ς rain. Skt. SU (su-nó-mi) press out juice, sū-mā-m milk, water, sky... We may with some probability place here also ὑάλος, ὕελος." Prellwitz, Etym. Wörterb. ed. 2, 473: ὑάλεος, ὕαλιος gläsern, wasserklar: ὕω". Thes. Gr. Ling. 8, 7.

⁴Froehner, La Verrerie, 6: "J'aimerais mieux prendre la voyelle v pour un ancien digamma, ce qui nous ramènerait au sel minéral (ἄλς, Et cette étymologie n'est pas si maladroite, car le verre est une espèce de sel; des chimistes autorisés l'ont ainsi défini." This conjecture seems the most probable to Morin-Jean (Darembert-Laglio,

word.¹ Some would derive it from the Coptic,² because the first mention of glass in Greek is in connection with the Egyptians. Others try to find some connection with the Latin vitrum,³ 'glass,' or the element sualo -- "transparent stone or the like."⁴

2. Application of Hyalos.-- Whatever may be the source of the word hyalos, it seems to have been introduced to designate transparent glass. Since the word was new and the substance which it designated rather unfamiliar, it is not strange that it should be applied to other substances of a vitreous appearance. That is just what happens in the first instance where the substantive occurs in literature. To be sure, the use of the adjectival form, hyalinus, by Corinna⁵ implies an earlier use of hyalos than those recorded. Unfortunately the passage from Corinna is so obscure that we can learn nothing about glass from it. In Herodotus there is a description of coffins of hyalos among the marvels shown by the Aethiopians to the spies of Cambyzes. "And after this, last of

Dict. des Ant. Gr. et Rom. 5, 935) and Kisa, Das Glas im Altert. 3, 24, but it implies a knowledge of chemistry on the part of the early Greeks which is altogether improper for one to assume.

¹Blümner, Glas (P. W. 7, 1385).

²Thes. Gr. Ling. 8, 9: "Σαλος fortasse ortum ex Aegyptiaco ουαλις· ουαλα, quod Lapidem pellucidum, non vero proprie Vitrum nostrum significat. Jablousk, Opusc. 1, 250." Becker, Gallus, ed. 2, Ex. 1 on scene 7.

³L. Meyer, Handb. d. Gr. Etym. 2, 141: "Dunklen Ursprungs. Denkbar wäre ein Zusammenhang mit lat. vitro (vitrum), Glass' (Publil. Syr. com. 14)."

⁴Boisacq, Dict. Etym. 996.

⁵Phryn. 309: καὶ ἡ Κόρινθα τὸν Σάλινον παῖδα θύσεις.

all, they saw their coffins, which are said to be made of hyalos in the following manner: When they have dried the body of the dead, either according to the Egyptian or some other fashion, they cover it entirely with gypsum and decorate it with painting, making it as nearly like the figure of the person as possible and then they put about it a block of hyalos which has been hollowed out (they dig up a quantity of this of a kind easily worked). The corpse is in the middle of the block and can be seen through it, but it does not produce an unpleasant odor or anything else unseemly, and it has everything visible like the corpse itself. For a year those most closely related keep the block in their houses giving it the first fruits of everything and offering sacrifices to it. And after these things they take it out and place it near the city."¹ This passage has caused not a little perplexity. All are agreed that hyalos does not mean glass, but the substance for which it does stand is uncertain.² Although this whole account is probably

¹Hdt. 3, 24: μετὰ δὲ ταύτην τελευταίας ἐθεήσαντο τὰς θήκας αὐτῶν, αἱ λέγονται σκευάζεσθαι ἐξ ὑάλου τρόπῳ τοιῷδε· ἐπεὶ τὸν νεκρὸν ἰσχυρῆναι, εἴτε δὴ κατὰ περ Αἰγύπτιοι εἴτε ἄλλως κως, γυψώσαντες ἅπαντα αὐτὸν γραφῇ κοσμέουσι, ἐφομοειῦντες τὸ εἶδος ἐς τὸ δυνατόν. ἔπειτα δὲ οἱ περιστᾶσι στήλην ἐξ ὑάλου πεποιημένην κοίλην (ἢ δὲ σφι πολλήν καὶ εὐεργὸς ὀρύσσεται). ἐν μέσῃ δὲ τῇ στήλῃ ἐνεῶν διαφαίνεται ὁ νέκυσ, οὔτε ὁδμὴν οὔδε μίαν ἀχαρὶν παρεχόμενος οὔτε ἄλλο ἀεικὲς οὔδέν· καὶ ἔχει πάντα φανερά ὁμοίως αὐτῷ τῷ νέκυϊ. ἐνιαυτὸν μὲν δὴ ἔχουσι τὴν στήλην ἐν τοσούτοις οἰκίοις οἱ μάλιστα προσήκοντες πάντων τε ἀπαρχόμενοι καὶ θυσίας οἱ προσάγοντες· μετὰ δὲ ταῦτα ἐκκομίσαντες ἵστασι περὶ τὴν πόλιν.

²Belzoni, Researches, 236 (quoted in Thes. Gr. Ling. 8, 8): "Oriental alabaster." Thes. Gr. Ling. 8, 8: "crystal." Rawlinson, Herodotus, 2, 350: "It should be rock crystal; but no piece of this substance could be found large enough to hold a body. It may have been some vitreous composition, coating the stone coffins in the form of a mummy, some of which are found in Egypt." Compare Sayce, Herodotus, 1-3, 240, 7. Abicht, Herodotus, ed. 3, 2, 26: "Vielleicht eine Art Steinsalz." Vaniček, Gr.-Lat. Etym. Worterb. 1046: "Glasporzellans." Blümner, Tech. u. Term. 4, 384: "Ein

fabulous,¹ it shows that Herodotus applied hyalos to a transparent material which was dug out of the ground, and also that the Egyptians or rather Aethiopians perhaps occasionally used some transparent substance about their dead. Ctesias² attests such a use, but his authority is very slight to begin with, and besides it is impossible to tell whether he meant that the Aethiopians used actual glass or not, for Diodorus by whom this passage has been preserved may have misrepresented him as much as he has Herodotus.³ Diodorus interprets hyalos as actual glass which was poured about the dead. He says that they made so much of it in Aethiopia that there was enough for every one.⁴ Strabo is probably taking the word of an earlier writer when he says of the Aethiopians, "some pour hyalos about the dead and keep them at home."⁵ In another place, he speaks of the body of Alexander having

natürliches, aus der Erde gegrabenes Material." Note 1: "Die Erklärer denken an durchsichtiges Glasporzellan, andere mit mehr Wahrscheinlichkeit an Bergkrystall." Liddell and Scott, s.v. "Some kind of clear, transparent stone."

¹Niebuhr, Vorträge über alte Gesch. 1, 151; Rawlinson, Herodotus 2, 350, 2; How-Wells, A Comm. on Herodotus, 1, 240, 7.

²Diod. 2, 15, 2 ff.: Κτησίας δ' ὁ Κνίδιος ἀποφανόμενος τοῦτον σχεδιάζειν, αὐτός φησι τὸ μὲν σῶμα ταριχεύεσθαι, τὴν μὲντοι γέυελον μὴ περιχεῖσθαι γυμνοῦς τοῖς σώματι· κατακαυθήσεσθαι γάρ ταῦτα καὶ λυμανθέντα τελέως τὴν ὁμοιότητα μὴ συνήγεσθαι διατηρεῖν. διὸ καὶ χρυσὴν εἰκόνα κατασκευάζεσθαι κοίλην, εἰς ἣ ἔντεθέντος τοῦ νεκροῦ περὶ τὴν εἰκόνα χεῖσθαι τὴν γέυελον· τοῦ δὲ κατασκευάσματος τεθέντος ἐπὶ τὸν τάφον διὰ τῆς γέλου φανῆναι τὸν χρυσὸν ἀφωμοιωμένον τῇ τετελευτηκότῃ.

³Ibid. 2, 15, 1: ταφὰς δὲ τῶν τελευτησάντων τῶν ἰδῶς οἱ κατὰ τὴν Αἰθιοπίαν ποιοῦνται· ταριχεύσαντες γάρ τὰ σώματα καὶ περιχέαντες αὐτοῖς πολλὴν γέυελον ἰστᾶσιν ἐπὶ στήλης, ὥστε τοῖς παριούσι φαίνεσθαι διὰ τῆς γέλου τὸ τοῦ τετελευτηκότος σῶμα, καθάπερ Ἡρόδοτος εἶρηκε.

⁴Ibid. 2, 15, 4: τὴν δὲ γέυελον πᾶσιν ἐξαρκεῖν διὰ τὸ πλεῖστην γέννησθαι κατὰ τὴν Αἰθιοπίαν καὶ τελέως παρὰ τοῖς ἐγγυρκοῖς ἐπιπολάζειν.

⁵Strabo, 17, 2, 3: τοὺς δὲ νεκροὺς οἱ μὲν εἰς τὸν ποταμὸν ἐκρίπτουσιν, οἱ δ' οἴκοι κατέχουσιν περιχέαντες γέυελον.

been changed from a gold to a glass sarcophagus.¹ Aelian² relates how Xerxes found the body of Belus in a glass sarcophagus full of oil. Such stories sound extremely fabulous. Lucian³ ascribes to the people of India the practice of smearing the dead with hyalos,⁴ an expression which surely suggests a substance other than glass. The Pseudo-Callisthenes⁵ describes the body of Cyrus in a coffin with glass poured about it. The Latin version of Julius Valerius⁶ where the coffin is described, uses the expression lapide visendo, 'of transparent stone.' There seems then to have been a custom among the Egyptians, Aethiopians, and Eastern nations of covering the bodies of the dead or the cases in which they were enclosed with something transparent, called hyalos. This could not have been a stone, for it was 'smeared,' or 'poured,' nor could it have been glass or even a glaze, because that cannot be poured except at

¹Ibid. 17, 1, 8: τὸ δὲ σῶμα τοῦ Ἀλεξάνδρου κομίσας ὁ Πτολεμαῖος ἐκκένευεν ἐν τῇ Ἀλεξανδρείᾳ ὅπου νῦν ἐτι κεῖται· οὐ μὲν ἐν τῇ αὐτῇ πυέλῳ· ὑαλίνη γὰρ αὕτη, ἐκεῖνος δ' ἐν χρυσῇ κατέβηκεν.

²Var. Hist. 13, 3: Πέρσης δ' Δαρείου παῖς τοῦ Βήλου τοῦ ἀρχαίου διασκέψας τὸ μνηματεῖον βελὴν εὗρεν, ἐνθα ἦν κείμενος ὁ νεκρὸς ἐν ἐλαίῳ.

³Luc. de Luctu, 21: Τινὸς ὑαλῷ περιχρίει.

⁴Wallace-Dunlop, Glass in the Old World, 24: "In the word hyalus the Greeks seem to have included not only glass but everything that was of a crystalline colour, all pellucid bodies such as ice, and even gums, as Lucian uses the same word in describing the Indians anointing their dead with balsamic gums."

⁵2, 18: παραπλήσιον δὲ ἐθεάσατο καὶ τὸν Κύρου τάφον· ἦν δὲ πύργος ἀθρῖος δωδεκάστεγος, ἐν δὲ τῇ ἄνω στέγῃ ἔκειτο αὐτὸς ἐν χρυσῇ πυέλῳ, καὶ ὕεος περιεκέχυτο αὐτῷ, ὥστε τὸ τρίχωμα αὐτοῦ φαίνεσθαι καὶ αὐτὸν δὲ ὅλον διὰ τοῦ ὕεου.

⁶Ps. Callisth. 2, 18: ipsius vero Cyri conditorium erat lapide visendo, cuius sive natura perpiscua, sive insculptio adeo tenuis erat, ut nihilo prorsus quicquid interesset impediret intuentium diligentium, adeo ut propter saxi illius evidentiam capilli etiam conditi cadaveris viserentur.

such a temperature that it would utterly disfigure any corpse. If we are to believe any part of the accounts at all we must think of a transparent varnish, shellac, or lacquer. Some authors no doubt wittingly called a substance which was not glass hyalos, while others perhaps mistook a substance vitreous in appearance for real glass, or, finally, a foreign word may either have been mistaken for glass, or else it may have been used generally of several transparent, glistening substances, including glass, and the Greek authors were not aware of this fact. In any case this tradition does not deal with glass as we know it.

Although the hyalos, the burning-glass kept at the druggist's shop in the Nubes of Aristophanes, was probably of glass, a scholiast has interpreted it as crystal.¹ This shows that the scholiast, at least, thought that hyalos might designate crystal. Achilles Tatius seems to indicate rock-crystal when he describes a cup of hyalos orôrygmenê, 'glass that has been dug up.' About the cup was a vine from which hung grapes so skillfully engraved that when the cup was empty, they looked unripe but when it was full of wine, they looked red and ripe.² After finding hyalos used in

¹ Schol. on Aristoph. Nub. 766: [τοῖσι φαρμακοπῶλαι: φαρμακοπῶλαι κυρίως οἱ τὰ φάρμακα πιπράσκοντες, τὰ τε λυσιτελοῦντα καὶ τὰ θανάσιμα. παρὰ τοῖς παλαιοῖς δὲ καὶ οἱ τοὺς τιμαλφεῖς (τούτέστι πολυτίμους) λίθους πιπράσκοντες, φαρμακοπῶλαι ἐλέγοντο. οὐδεὶς γὰρ τῶν τοιούτων λίθων, ὃς οὐκ ἔχει καινότεραν δύναμιν. Jun t.] τὸν κρύσταλλον. R.V.

Ach. Tatius, 2, 3: ὕαλου μὲν τὸ πᾶν ἔργον ὀρωρυγμένης· κύκλῳ δ' αὐτὸν ἄρπελοι περιέστεφον ἀπὸ τοῦ κρατῆρος πέφυτευμένοι. οἱ δὲ βότρυες πάντῃ περικρεμάμενοι· ὅρμαξ μὲν αὐτῶν ἕκαστος ὅσον ἦν κενὸς ὁ κρατὴρ· εἰάν δ' ἐγχέης οἶνον, κατὰ μικρὸν ὁ βότρυς ὑποπερκάζεται καὶ σταφυλὴν τὴν ὀρμακα ποιεῖ. Διόνυσός τ' ἐντετύπεται τῶν βοτρυῶν, ἵνα τὴν ἄρπελον γεωργῇ.

such a way, it does not seem strange that Pollux should list it among the things that are mined.¹

The first certain use of hyalos or any of its derivatives in the meaning of 'glass' seems to be in Aristophanes,² for hyalinós in Corinna and hyaloeides in Philolaus and Ion of Chios, although probably designating ordinary glass, cannot, because of their employment in mere comparisons, be regarded as unequivocally presupposing at that time the application of hyalos to glass rather than to crystal or some other transparent precious stone, but those who think that the burning-glass was made of crystal mention Plato³ as the first to apply hyalos to actual glass.⁴ Although its use was rather uncommon at first, in time it became so well known that hyalos alone was employed to designate a glass vessel.⁵ The chief characteristic of hyalos, 'glass,' as might be expected from its application to other substances of a vitreous appearance, was transparency. Not only was its transparency frequently mentioned or inferred,⁶ but it was used as a standard with which to

¹Pollux, 3, 87: χρυσός, ἄργυρος, ὀρείχαλκος, σίδηρος, καττίτερος, ῥόμβρος, ὕαλος.

²Nub. 768. Compare Ach. 74: ἐξ ὑαλίνων ἐκπωμάτων.

³Tim. 61 B.

⁴Thes. Gr. Ling. 8, 7.

⁵Galen, 13, 42, 290; Apocryphal Gospels (in Textes et Docum. 1, 1, 26, 31, 32); Orib. (Darembert-Ruelle, Oeuvre de Rufus d'Éphèse, 569); Geop. 9, 19, 10.

⁶Aristot. Probl. 11, 905 B, 6, 25, 939 A, 13; Analyt. Post. 1, 31, 88 A, 14. Hero, Definitiones, 4, 102, 16: καὶ καθ' ἕτερον δὲ τρόπον ὑποτίθεται τὰ μὲν δι' αἰθέρος καὶ ἀέρος δρώμενα κατ' εὐθείας γραμμὰς δρᾶσθαι φέρεσθαι γὰρ πᾶν φῶς κατ' εὐθείας γραμμὰς ὅσα δὲ διαφαίνεται δι' ὕδατος ἢ ὑμένων ἢ ὕδατος, κατὰ κεκλασμένας, τὰ δὲ φαινόμενα ἐν τοῖς κατοπτρίζουσι κατὰ ἀνακλωμένας [γωνίας]. Id. 106, 3: ὅποια γὰρ ἢ τῶν ὀψέων πρόσπτωσις, τοιοῦτος καὶ ὁ καταφωτισμὸς ὑπὸ τοῦ ἡλίου γίνεται, καὶ τότε μὲν κατ' εὐθείας ἀκλᾶστους, τότε

compare anything else which is transparent.¹ It even developed a

δὲ κατὰ δυσμένας, ὥσπερ ἐπὶ τῶν υέλων. Id. 106, 10: ἡ δ' ἐπὶ τῶν υδάτων καὶ τῶν υμένων τὰ κατὰ διάδυσιν θεωροῦσα ὀπτική ἐλάττω μὲν θεωρίαν ἔχει, αἰτιολογεῖ δὲ τὰ ὑπὸ τοῖς υδασι καὶ υμέσι καὶ δέλοις, ὅποτε διασπαρραττόμενα φαίνεται τὰ ἡνωμένα καὶ σύνθετα τὰ ἀπλᾶ καὶ τὰ ὀρθὰ κεκλασμένα καὶ τὰ μένοντα κινούμενα.

Idem, de Speculis, 3: In aquis autem in vitris <non> omnes refringuntur ... per vitrum enim et per aquas videmus non ipsos et ultra iacentia. in palustribus enim aquis que in fundo videmus et per vitra eaque ultra iacent. Alex. Aphrod. on Arist. de Anima, 138, 28: γελοῖον γὰρ τοι τὸν μὲν λίθον τὸν διαφανῆ ἢ τὴν ὕαλον μὴ λέγειν εἶναι σώμα, τὸ δὲ φῶς λέγειν. Ibid. 149, 26: ἡ δὲ ὕαλος καὶ τὰ διαφανῆ, οἷς τοὺς οἴκους βράττουσιν, ὕδατος ἐστίν, ὡς δῆλον ἐκ τῆς γενέσεως αὐτῶν.

Idem on Arist. Metaphysica, 588, 40: ὥσπερ εἴ τις ἐν κηρῷ πλάσας εἶδος τι κήρινον καὶ ἐκτὸς ἐπιθεῖς ὕαλον ἢ ἄλλο τι τῶν διαφανῶν, ὁρᾶται τὸ ἐντὸς ἀντὶς κήρινον εἶδος. Damascius, Dubitationes et Solutiones (ed. Ruelle, 1, 183, 11): ὡς εἰ λέγοις ὕαλον ἦτοι τῶν διαφανῶν ὅλον δρατόν.

Philoponus on Arist. de Anima, 319, 15: ἐπεὶ δὲ ὁδὴ ἐν τῷ δριμύτι τοῦ χρώματος ἐρνήσθη τοῦ διαφανοῦς, διδάσκει ἡμᾶς, τί ποτέ ἐστι τὸ διαφανές, ὅτι φύσις τίς ἐστίν ἐν πλείοσιν ὑπάρχουσα, ἐν ὕδατι, ἐν ἀέρι, ἐν ὕελῳ καὶ ἐν ἑτέροις, διαπορθρευτική τῶν χρωμάτων, ἢ τις φωτὸς μὲν μὴ παρόντος δυνάμει ἐστίν αὐτὸ τοῦτο διαφανές, ἐνεργεία δὲ γίνεται διαφανές φωτὸς παρόντος.

Ibid. 320, 26: σημεῖον δὲ τούτου, ὅτι εἰ ὕελου ἢ διαφανοῦς λίθου

μία ἐπιφάνεια χρυσθεῖται. Idem on Arist. Meteor. 44, 1: ἐπειτα πολλοὶ τῶν στερεομνηωτάτων λίθων εἰσὶ διαφανέστατοι καὶ ἡ ὕαλος... ὁρᾶται γὰρ τὰ ἐν τούτων τριβόμενα καὶ μάλιστα τὰ ἐξ ὕελου σχεδὸν ἐκπυρούμενα τῇ θερμότητι.

Suid. 1319, 18: διαφανές ἐστὶ δὲ διαφανῆ οὐκ ἀπὸ μόνον καὶ ὕδαρ ἀλλὰ καὶ πολλὰ τῶν στερεῶν σωμάτων ὅσον φεγγίται λίθοι, κέρατα, ὕελοι, γύψος καὶ ἕτερα. Nemesius, de Natura Hominis (Patr. Gr. 40, 645 B): ἦττον δὲ διὰ ὕελου καὶ τῶν ἄλλων τῶν τοιοῦτοτρόπων, δῆλον δὲ, ὅτι πεφωτισμένων.

Transparency is mentioned frequently in connection with glass objects which will be spoken of later.

¹

Topaz is compared to glass. Agatharchides, de Mari Erythraeo (Müller, Geog. Gr. Min. 1, 170), in Photius: ἐν δὲ ταύτῃ γίνεται τῇ νήσῳ, φησὶ, καὶ τὸ καλούμενον τοπάχιον. ἐστὶ δὲ τοῦτο λίθος διαφανόμενος, ὕαλῳ (γάλῳ BA) παρεμφερής, ἡδεῖαν ἐγχρυσόν θεωρίαν ἀποδιδούς. In Diodorus, 3, 39, 5: εὐρίσκεται γὰρ ἐν τῇ νήσῳ ταύτῃ τὸ καλούμενον τοπάχιον, ὅπερ ἐστὶ λίθος διαφανόμενος ἐπιτερπής, ὕαλῳ παρεμφερής. Psellus, de Lapid. 25: τοπάχιον λίθος ἐστὶ διαφανής, ὕελῳ παρεμφερής. The city and the streets of Heaven are compared to pure or transparent glass. Here there seems to be the idea of brightness as well as transparency. Rev. 21, 18: καὶ ἡ πόλις χρυσεῖον καθαρὸν ὅμοιον ὕαλῳ καθαρῷ. Id. 22: καὶ ἡ πλατεῖα τῆς πόλεως χρυσεῖον καθαρὸν ὡς ὕαλος διαυγής.

Andreas Caesar. (Patr. Gr. 106, 437) on Rev. 21, 21: διὰ τὴν πλατεῖαν τῆς πόλεως, διὰ μὲν τὸ πολυτελές καὶ εὐχρουν, ὡς χρυσεῖον, διὰ δὲ τὸ καθαρὸν, ὡς κρυστάλλου ἐθεάσατο, [ἦτοι ὡς ὕαλον διαυγῆ] ἅπερ ἀμφοτέρω ἐν ἐνὶ συνδραμεῖν παρ' ἡμῖν, ἀδύνατον.

figurative meaning with which moral qualities might be compared.¹
 It is to molten glass more frequently than to merely transparent glass that the physicians compare the vitreous humor of the eye,² and humors of the body.³ Some of the other characteristics are

Of the joinings of bones, Anaphora Pilati, 2 (ed. Tischendorf, Evang. Apoc. 422): καὶ γυναῖκα αἱμορροοῦσαν ἐπὶ χρόνοις πολλοῖς, ὡς ἐξ αὐτῆς τῆς ῥύσεως τοῦ αἵματος πᾶσαν τὴν τῶν ὀστέων ἄρμονίαν φαίνεσθαι καὶ ὕλου δίκην διαυγάζειν.

Of bubbles in raindrops, Alex. Aphrod. Probl. 2, 39: καθάπερ καὶ τῶν ὕαλον ἔστιν ἰδεῖν ὑπὸ τοῦ πνεύματος φυσωμένην, καὶ πᾶν ὑγρὸν ἐν τῇ ἐψήσει πνευματούμενον.

Of skin, Ibid. 2, 4: τῇ δὲ λεπτότητι τοῦ δέρματος ὡπερ δι' ὕλου ἐμφαίνεται τὸ εὐανθές τοῦ χρώματος. Rufinus (Anthol. Pal. 5, 36): τῆς δὲ Ῥοδοκλείης ὕαλω ἴσος, ὑγρομέτωπος, οἷα καὶ ἐν νηφί πρωτογλυφές ξόανον.

According to Jacobs, "Vitri similitudo ad laevitatem referenda est." There is a clear, thin skin which looks almost transparent.

¹ Photius, Myriobiblon, 275 (Patr. Gr. 104, 244 A): ὅτι, φησὶν, αἱ ἱστορίαι τὴν Μαγδαληνὴν ταύτην διὰ βίου παρθένον διδάσκουσι. καὶ μαρτύριον δὲ αὐτῆς φέρεται, ἐν ᾧ λέγεται διὰ τὴν ἄκραν αὐτῆς παρθενίαν καὶ καθαρότητα ὡς ὕαλον αὐτὴν καθαρὸν ταῖς βασανισταῖς φαίνεσθαι.

² Galen, 3, 761: τὸ ὑαλοειδὲς ὑγρὸν, καὶ ὅσω παχύτερον καὶ λευκότερον αἷματός ἐστι, τοσοῦτον τοῦ κρυσταλλοειδοῦς ὑγροῦ ἀπολειπόμενον ὑγρότητί τε καὶ φανότητι. τὸ δ' ὑαλοειδὲς ὑγρὸν μὲν ὡπερ τις ὕαλος ὑπὸ θερμοῦ κεχυμένη.

Aëtius, Ἱατρικά, 7 (in the edition, Die Augenheilkunde, Hirschberg), I: ὑγρὰ δὲ ἔστιν ἐν τῷ ὀφθαλμῷ τρία· ἐνδοθεν μὲν πάντων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀμφιβληστροειδοῦς χιτῶνος ὑελοειδὲς λεγόμενον· προσέοικε γάρ, καὶ τῇ χροίᾳ καὶ τῇ συστάσει, τῇ κεχυμένη ὕαλω· τούτου δὲ ἐξωτερῶς κεῖται κατὰ τὸ πέρασ τοῦ ἀμφιβληστροειδοῦς χιτῶνος τὸ κρυσταλλοειδὲς ὑγρὸν, ὃ καὶ δισκοειδὲς καὶ φακοειδὲς καλεῖται· προσέοικε γάρ τῇ μὲν χροίᾳ κρυστάλλῳ τῷ δὲ σχήματι φακῷ· ἐξωθεν δὲ περικέχυται τούτῳ τὸ ὡοειδὲς ὑγρὸν· προσέοικε γάρ, τῇ χροίᾳ καὶ τῇ συστάσει, τῷ ἐνδοθεν ὡς ὑγρῷ τῷ λευκῷ καὶ λεπτῷ· τὸ μὲν οὖν πάντων ἐνδοθεν τὸ ὑελοειδὲς ὑγρὸν πρὸς τὸ τρέφειν τὸ κρυσταλλοειδὲς παρεσκευάζεται.

³ Galen, 7, 138: τοιοῦτον δὲ ἔστι παραπλήσιον ὕαλω κεχυμένη κατὰ τε τὴν χροίαν καὶ τὴν σύστασιν, ὅν περ δὴ καὶ ὑαλώδη χυμὸν οἱ περὶ τὸν Πραξαγόραν τε καὶ φιλότιμον ὀνομάζουσιν.

Ibid. 8, 81: τὸν ὑαλώδη προσαγυρευόμενον ὑπὸ Πραξαγόρου χυμὸν, δὲ ὕαλω κεχυμένη προσέοικεν τὴν χροίαν καὶ τὴν σύστασιν.

Ibid. 16, 367; 585 Orib. (Bussemaker-Daremborg, 5, 550 from Galen): ἔστι δὲ παχὺς οὗτος ὁμοίος που ὕαλω κεχυμένη τῷ πάχει.

brightness,¹ solidity,² brittleness,³ and possibly smoothness.⁴

Even after hyalos came to be the universal name for glass, it was still occasionally applied to other substances. Possibly it stands for a diamond in a puzzling letter of the early fourth century found among the papyri of the Fayum towns. "Eudaemon to Longinus greeting. I entreat you, sir, to hasten to me and bring, if you please, the crystal (?) and we can clip the cash. If you . . . , you will be able to strain me some good Mareotic wine when you come, with the value. Good-bye."⁵ The editors think that hyalos is "here a stone implement of some kind for clipping coins, in order that the writer might get some wine with the proceeds of this (nefarious) transaction." On the other hand, Bücheler gives an entirely different interpretation. He considers that Eudaemon merely wanted Longinus to bring a glass for his wine."⁶ Instances have been given of the use of hyalos alone for a glass vessel, and later a similar use of vitrum, especially for a goblet will be noted, all of which supports the latter interpretation.

¹Rev. 21, 18, 21. Suid. ἐνδῖος· μεσημβρινός· ὅφρα μὲν οὖν ἐνδῖος ἔην ἔτι, θέρμετο δὲ χθών, τόφρα δ' ἔην ὑάλοιο φάντερος οὐρανός ἢ νοψ.

²Alex. Aphrod. on de Anima, 133, 18: εἰ δὲ λέγοιεν τὸ στερεὸν ἐπιπροσθεῖν στερεὰ καὶ ἡ ὑαλός καὶ τὸ κέρας καὶ οἱ διαφανεῖς λίθοι.

³Alex. Aphrod. Probl. 41, 28, children are not hurt by a fall: τῷ λόγῳ τούτῳ καὶ σπῶγγος πίπτων οὐ ῥήγνυται, ὑέλος [sic!] μέντοι ἢ ὄστρακον, ἥτις τοιοῦτον σῶμα σκληρὸν πίπτον κλάται.

⁴Rufinus (Anthol. Pal. 5, 36).

⁵Grenfell-Hunt-Hogarth, Fayum Towns and Their Papyri, 134: Εὐδαίμων λογγεῖνω χαίρειν. παρακληθεῖς κύριε σκυλὸν σεαυτὸν πρὸς ἡμᾶς φέρων εἰ δόξαι σοὶ τὴν ὑαλὸν καὶ συνηθῶμεν [εν] τὸ λογγεῖν περικόψε, ἂν . . . [ς], καὶ καλὸν Μαρεωτικὸν συγ[ήσει] μοι σειρώσαι ἐρχόμενος [τι]ῆς τιμῆς ἔρρωσσο.

Translation by the editors.

⁶F. Bücheler (Rhein. Mus. 56, 326).

In Hesychius glass seems to be called a precious stone, but the passage is probably corrupt, for glass is also called borboros, 'mud,'¹ an absurdity due to a confusion with hyollos.² Theognostus seems to have copied the corrupt text of Hesychius and in turn to have been copied by Zonaras.³

A scholiast on Aristophanes' Nubes says that Homer did not know the word hyalos but used êlektros instead.⁴ This is repeated by Pseudo-Philemon.⁵ The Greeks designated both amber and a metallic compound of gold and silver by êlektron.⁶ Originally perhaps êlektros (masc.) stood for the metal while êlektros (fem.)

¹Hesych. ὑαλο(υ)ν λαμπρόν. πρᾶον. [ἡ λίθος τίμιος ὑαλος· ὕελος. [βόρβορος].

²Ibid. ὑολλός· τόπος συῶν βορβορώδης.
See Hesych. ed. Schmidt (1862), 4, 191, 18.

³Theognostus, Canones, 18, 28; Zonaras, Lex. 1759: ὑαλος ὁ βόρβορος, ἐνίοτε δὲ καὶ τὸ λαμπρόν.

⁴Schol. V on Nub. 768: Ὅμηρος δὲ οὐκ οἶδε τὸ ὄνομα, ἀλλὰ παρ' αὐτῷ καὶ τοῖς ἀρχαίοις ἤλεκτρος μὲν ἐστίν, ὑαλος δὲ οὐ.

⁵Lex. ed. Osann, 171.

⁶Paus. 5, 12, 7: τὸ δὲ ἤλεκτρον τοῦτο οὖ τῷ Αὐγούστῳ πεποιήνται τὴν εἰκόνα, ὅσον μὲν αὐτόματον ἐν τοῦ Ἡριδανοῦ ταῖς ψάμμοις εὐρίσκεται, σπανίζεται τὰ μάλιστα καὶ ἀνθρώπῳ τίμιον πολλῶν ἐστίν ἐνεκα· τὸ δὲ ἄλλο ἤλεκτρον ἀναμεμιγμένον ἐστίν ἀργύρῳ χρυσός.
Plin. N. H. 33: omni auro inest argentum vario pondere, aliubi decuma parte, aliubi octava. . . ubicumque quinta argenti portio est, electrum vocatur. fit et cura electrum argento addito. quod si quintam portionem excessit, incudibus non resistit. vetusta et electro auctoritas Homero teste, qui Menelai regiam auro, electro, argento, ebore fulgere tradit. Compare 36, 460. In Latin electrum was also used for the pure Latin sucinum, 'amber.' See P.-W., 3, 1, 296. Pliny, N.H. 37, 47: genera eius plura sunt. ex iis candida odoris praestantissimi, sed nec his cerinis pretium. fulvis maior auctoritas. ex iis etiamnum amplius tralucentibus, praeterquam si nimio ardore flagrent; imaginem igneam in iis esse, non ignem, placet. summa laus Falernis a vini colore dictis, molli fulgore perspicuis in quibus et decocti mellis lenitas placeat. Serv. Comm. in Verg. Aen. 8, 402: et secundum Plinium in naturali historia tria sunt electri genera; unum ex arboribus, quod sucinum dicitur; aliud, quod naturaliter invenitur; tertium, quod fit de tribus partibus auri et una argenti. Blümner, Tech. u. Term. (Bernstein), 2, 381 ff.; (Goldsilber) 4, 139, 160 ff.

and êlectron (neut.) stood for amber, but later these forms of the word were used indifferently.¹ It is uncertain whether Homer² meant amber or the metallic compound,³ but there is very little probability that he was speaking of glass.⁴ However, in the time of the scholiast there may have been some connection between glass and êlektron which led him to hold this view.⁵ In Suidas where the burning glass is described, there is a confusion of glass and êlektron.⁶ On the one hand, when êlektron stands for a metal, the

¹Lepsius, Die Metal in den Aegypt. Inschr. (Abhandl. de könige. Akad. 1871), 138 ff.

²Od. 4, 73 (71): φράγεο, Νεστορίδη, τῷ ἔργῳ κεχαρισμένε θυμῷ, | χαλκοῦ τε στεροπὴν καὶ δῶματα ἤχχεντα | χρυσοῦ τ' ἤλεκτρον τε καὶ ἀργύρου ἧς' ἐλέφαντος. Ibid. 15, 460 (459): ἦλυθ' ἀνὴρ πολυτίδρις ἔμοῦ πρὸς δῶματα πατρὸς | χρύσειον ὄρνον ἔχων, μετὰ δ' ἤλεκτροισιν ἔερτο. Compare 18, 296.

³Helbig, Das homer. Epos, ed. 2, 106.

⁴P.-W. 3, 1, 295: "Rev. archeol. 16, 1859, 235 und Lagrange Recherches sur la peinture en émail dans l'antiqu., Paris 1856, Glasfluss (Smalte), Feys in der Revue de l'instruct. publ. de Belg. 1863, 461 Glas. Doch hat keine dieser Annahmen Wahrscheinlichkeit für sich, und nur darum kann es sich handeln, ob bei Homer sowie in einigen späteren Erwähnungen des ἤλεκτρον Bernstein oder die den gleichen Namen führende Goldlegierung gemeint sei." Blümner, Tech. u. Term. 4, 408: "Die mehrfach aufgestellte Behauptung, welche namentlich an Labarte und Cohausen Vertheidiger gefunden hat, dass das homerische ἤλεκτρον Smalte bedeute, ist zweifellos unhaltbar. Wir haben ἤλεκτρον in verschiedenen Bedeutungen kennen gelernt, als Bernstein sowohl, wie als Silbergold; dass es daneben noch jene dritte Bedeutung gehabt habe, dafür lässt sich nirgends ein Anhalt finden."

⁵Ibid. 1. c.: "Allerdings unterliegt es keinem Zweifel, dass electrum im Mittelalter die Bedeutung von Schmelz erhalten hat; bei Theophilus (Schedula Divers. Art. III, 53) wird es mehrfach in diesem Sinne gebraucht, und in lateinischen Schriften des zehnten und elften Jahrhunderts kommt es ebensowohl in dieser Bedeutung, wie in der des silberhaltigen Goldes vor."

⁶Suidas: ὕαλη. ὕαλος. ὕαλος ἐστὶν ἀφ' ἧς πῦρ ἀπτουσι. καὶ φησὶν Ἀριστοφάνης. ὁπότεν γράφοιτο ἡ δίκη, ἀπωτέρω στὰς ὥδε πρὸς τὸν ἥλιον τὰ γράμματα ἐκτίθειμι τῆς ἐμῆς δίκης. ἐστὶ δὲ κατασκευάσμα ὕαλου τροχοειδὲς ἤλεκτρον, εἰς τοῦτο τεχνασθέν. ὅπερ ἐλαίῳ χρίσαντες καὶ ἠλίῳ θερμύναντες προσάγουσι θρυαλλίδα καὶ ἀπτουσι.

Suidas is here following very closely the scholia in RV on Aristoph. Nubes, 768, but seems to have interpolated the word ἤλεκτρον which does not appear in the scholia as they are transmitted in the MSS.

lexicons describe it as gold mixed with glass and stone.¹ A table in Sancta Sophia in Constantinople seems to have been made of this artificial product.² On the other hand, some forms of amber so closely resemble glass that they could easily be confused with it. In Hesychius logourion,³ which is probably the lynkourion⁴ mentioned elsewhere as amber, is defined as hyalos or hyelos. Perhaps the scholiast in V was thinking of an amber called hyalos. However that may be, the connecting of êlektron and glass by Hesychius, Suidas, and the scholiast in V, with the additional knowledge that glass and amber have been confused in other languages,⁵ and that the term glass was in Greek occasionally

¹Cyrrill (Zonaras, Lex. 1,106); Photius; Bachmann, Anecd. Gr. 1,250, 4; Suidas; Etym. Magn. 425, 25; Miller, Melanges, 147 (from Flor. Ms. 304); Zonaras, 986: ἤλεκτρον· ἄλλό τιπτον χρυσίον μεμιγμένον ὕδατος καὶ λιθία. Etym. Gud. 240,9, has μεμελαγχμένον instead of μεμιγμένον. Etym. Magn. adds οὕτως ῥητορικῇ.

²Suidas: ἤλεκτρον· ἄλλό τιπτον... λιθία· οἷας ἐστὶ κατασκευῆς ἡ τῆς ἀγίας σοφίης τράπεζα. Zonaras, Lex. 986: ἤλεκτρον· χάλκωμα καθαρὸν, ἢ ἄλλό τιπτον... τράπεζα, ὃ πανεφεύρετος τοῦ θεοῦ ναός. Salmas, Plin. exercit. 761 b.C: Pro ἄλλό τιπτον etiam non dubito quin apud Hesychium legendum sit, ὕδατος τιπτον. Sic ἄλλης λιθίας apud auctorem periplus pro ὕδατος λιθίας. Electrum autem ὕδατος τιπτον χρυσέον eleganter vocatur, quasi dicas vitreum aurum, quod auri formam habeat simul et vitri. De succino id intelligendum. Similiter et in hac voce corrigendus. Eudemus Rhetor: ἤλεκτρον ὕδατος τιπτον χρυσίον, μεμιγμένον μετὰ ὕδατος καὶ λιθοῦ. Perperam apud eum legitur, ἄλλό τιπτον.

³Hesych: λογούριον· ὕδατος. Λάκωνες. λογούριον. ὕδατος. For a discussion of the spelling see P.-W. 3, 1, 301 ff.; M. Schmidt, Hesych. 3, 47, 12. In this same note there is a discussion of Hesych. αἰτύρον· ὕδατος, which Schmidt would take as a mistake for λίγυρον, 'amber.' Others connect it with the Latin vitrum. See Curtius, Gr. Etym., ed. 5, 579.

⁴Hesych.: λυγκούριον· τὸ ἤλεκτρον. "λυγκουργόν - ἤλεκτρον, cod., prius Salmasius posterius Mus. correxerunt," Schmidt. On the origin of the name see Theophrastus, de Lapid. 28; Pliny, N.H. 37, 34.

⁵Boisacq, Dict. Etym. 996. Blümner, Tech. u. Term. 2, 383, 1, and P.-W. 3, 1, 297, note the similarity between glass and the German word for amber given by Pliny in N.H. 37, 42: ab Germanis appellari glaesum.

applied to other transparent substances, has led several modern scholars to believe that hyalos might also designate amber.¹ Some would go so far as to suggest the correspondence of hyalo- to sualo-² which appears in sualiternicum, the Scythian name for amber according to Pliny.³

Conclusion: Although hyalos usually meant glass, it was also applied to other transparent substances, such as crystal, glazes, precious stones, and amber, as has been shown. This probably arose through a confusion at a time when the precise nature of these different substances was as yet not recognized and then the erroneous usage was never entirely corrected. But it is also conceivable that even after glass had become better known, hyalos may have been intentionally applied to other things because of the similarity in their appearance.

¹ Sonne, Kuhns. Zeitschr. 12, 359; Curtius, Gr. Etym. ed. 5, 395. Froehner, La Verrerie, 5: "Il ne serait donc pas impossible qu'on eût employé parfois le même terme pour désigner les deux matières." Thes. Gr. Ling. 8, 127: "Non est autem succino color unus. . . aliud fulvum et perspicuum instar vitri, quod genus Gr. nuncupant ὕαλον".

² Prellwitz, Etym. Wörterb., ed. 2, 472, considers this as doubtful. However, Boisacq, Dict. Etym. 996: "ὕαλο- semble répondre à l'élément sualo- 'pierre transparente ou qc. de pareil' du nom scythe, c-à-d. Nord-européen, de l'ambre sualiternicum."

³ N. H. 37, 33: Philemon fossile esse et in Scythia erui duobus locis, candidum atque cerei coloris quod vocaretur electrum, in alio fulvum quod appellaretur sualiternicum. (hyalopyrrichum in Urlichs, Vind. Plin. 2, 824, accepted by Detlefsen, ed. 1873).

3. Forms and Orthography: a. Hyalos (hyelos), the substantive.-- Hyalos is ordinarily feminine, presumably under Attic influence,¹ the masculine gender appearing very rarely.² With very few exceptions³ the accent comes upon the antepenult. The first vowel is short, but in late poetry it is occasionally treated as long, metri gratia,⁴ in some of the derivatives.

The first form of the word hyalos, which we have preserved, at least, is hyalinus, used by Corinna, as mentioned above.⁵ Hyaloeides occurs in Philolaus,⁶ while hyeloeides in Ion of Chios⁷ attests the employment of the spelling with epsilon in the fifth century, B.C. Herodotus⁸ is the first to use the substantive form

¹ Schol. Pind. Ol. 1, 10: ἐπεὶ καὶ οἱ Ἀττικοὶ πολλὰ τῶν ὀνομάτων ἄρσενικά ὄντα θηλυκῶς ἐκ φέρουσιν. Ael. Dionys. in Eustath. 1390, 50 ff.: παρὰ τῷ Ἀθηναίῳ Ἀέλιος δὲ Διονύσιος παρασημειούμενος τίνα ὅπως κατὰ γένη προφέρονται, φησὶν οὕτω... θηλυκῶς... καὶ ἡ ὕαλος. Photios, s.v. ὕαλος. Bachmann, Anecd. Gr. 1, 392; Schol. Aristoph. Nub. 768; Zonaras, Lex. 1759; Ety. Magn. 774, 3 ff.; Ps. Philemon, Lex. Technol. 248.

² Theophr. de Lapid. 49: εἰ δὲ καὶ ὁ ὕελος ἐκ τῆς ὑελίτιδος ὥς τινὲς φασί. Alex. Aphrod. on Arist. de Anima, 142 (ed. I. Bruns): τοιαῦτά ἐστι τῶν διαφανῶν τὰ τε κάτοπτρα καὶ οἱ ὕελοι, where the editor emends οἱ to αἱ, perhaps without sufficient warrant. In Lucian, Quomodo Hist. Conscr. Sit, 25, one of the mss., Vat. 87, reads τῷ ὕάλῳ which, however, may be a mere slip.

³ Philostratus, Vita Ap. 3, 1: καὶ στέγει αὐτοπλῆν ὕελοῦ οὐδέν. Athanasius (Patr. Gr. 28, 789 B: ἀνατείλας τοῦ ἡλίου αἱ ἄκτινες αὐτοῦ διαπερῶσι τὸν ὑελόν... ὁ ὕελος οὐ συντρίβεται. Steph. Alex. 3, 20: καὶ ὕελων τῇ ὕσῃ. Alex. Aphrod. Problem. 1, 41, 28: τῷ λόγῳ τούτῳ καὶ στόγγος πίπτων οὐ ῥήγνυται, ὕελος μέντοι ἢ ὄστρακον, ἢ τι τοιοῦτον σῶμα σκληρὸν πίπτον κέεται. Orion (Sturz) and Ety. Gud. (Sturz). 5, 39, 63: ὕελός, ἐκ μεταφορᾶς τῆς ὕλης.

⁴ Thes. Graec. Ling. 8, 9; W. Schulze, Quaest. Epi. 180.

⁵ See above p. 20.

⁶ See below p. 50.

⁷ See below p. 51.

⁸ Hdt. 3, 24. There is some variation in spelling. Hyelos occurs only once in manuscript P of the fourteenth century while hyalos appears uniformly in the earlier manuscripts and also in P in another instance in this same passage.

of hyalos, although, as we have seen, he does not apply it to actual glass. Then follows its use in Aristophanes,¹ Plato,² and Aristotle³. In the latter hyelos also occurs. On account of the different manuscript tradition for the separate works of Aristotle, it is impossible to tell which form Aristotle himself really used. In Theophrastus⁴ hyelos appears regularly. The two forms, hyalos⁵

¹Nub. 768.

²Tim. 61 B.

³Arist. Meteor. 4, 10, 389 A, 8: χρυσὸς μὲν δὴ καὶ ἄργυρος καὶ χαλκὸς καὶ χαλκίτερος καὶ μόλυβδος καὶ ὕαλος καὶ λίθοι πολλοὶ ἀνώνυμοι ὕδατος πάντα γὰρ ταῦτα τέκεται θερμῷ. "ὕεμος B rec. F corr. m. 1 HN corr. m. 1: βέλος N. de Color. 3, 794 A: ἐπὶ δὲ τῶν πυκνῶν ἐπὶ πάντων ἐπιφαίνεται τις ἀχλύς, καθάπερ ἐπὶ τοῦ ὕδατος καὶ ὕαλου (ὕελου X) καὶ τοῦ ἀέρος.

Probl. 11, 905 B, 6 ff.: διὰ τοῦτο καὶ μὲν τῆς δέλου διοράται πυκνῆς οὐσῆς... ἀλλ' ἐνία κωλύεται διὰ τὴν μικρότητα τῶν πόρων οἷον ἢ ὕελος.

Ibid. 25, 939 A, 13 ff.: ἐπαλλάττουσι γὰρ οἱ πόροι, ἀλλ' οὐκ ἐν τῇ ὕαλῳ. ὁ δὲ αἷρ οὐκ κωλύεται διὰ τὸ μὴ εὐθυπορεῖν οὐ διερχεται.

Analyt. Post. 7, 3, 88 A, 14: οἷον εἰ τὴν ὕελον τετραπλημένην ἑωρῶμεν καὶ τὸ φῶς διόν, δῆλον ἂν ᾔην καὶ διὰ τί καίει, τῷ δρᾶν μὲν χωρὶς ἐρ' ἐκάστης, νοῆσαι δ' ἅμα ὅτι ἐπὶ πασῶν οὕτως.

Stob. Ecl. 1, 52 (Diels: Doxogr. 456): Ἀριστοτέλης δρᾶν ἡμᾶς κατὰ κίνησιν τοῦ κατ' ἐνέργειαν διαφανοῦς. διαφανὲς δὲ οὐ μόνον εἶναι τὸν ἀέρα, ἀλλὰ καὶ τὸ ὕδωρ καὶ τινὰ τῶν συνισταμένων τοθέν, ὅν ὕαλον καὶ κρύσταλλον καὶ τινὰς τῶν λαμπρῶν λίθων.

⁴De lapid. 49; De igne. 73; Frag. 184: Ἰχθὺς ἱστορεῖ Θ. ὑπὸ ῥίγους πεπηγότας, ἃν ἀφεθῶσιν ἐπὶ τὴν γῆν, κατὰ γυννοθαι καὶ συντρίβεσθαι δίκην δέλων ἢ κεραμεῶν σωμάτων.

⁵Job. 28, 17; Agatharchides (Müller, Geog. Gr. Min. 1, 170, 6 ff.; 23 ff.). Strabo 3, 1, 5: διὰ δὲ τούτων ὥστ' εἰ αὐλῶν κλωμένην. G. Kramer, 1, 211, "81' ὕαλων proposuit Is. Voss. (ad. Mel. I, 18)." Müller-Dübner in their Latin translation suggest vitris, "quibus tanquam fistulis [vitris?] infractos radios visus diffundi." Ibid. 17, 2, 3; Antiphilos (Anth. Pal. 6, 250 or Suidas, s.v. νάρσος); Anon. Lond. Iatrica (H. Diels, Suppl. Aristot. 3a, col. 39, 18; Philo, Leg. ad Galum, 45 (some of the manuscripts give ὕελος); Peripl. Maris Erythr. 49, 56; Rev. 21, 18, 21; Ael. Dionys. in Eusth. 1390, 53; Galen. 3, 760; 5, 623; 7, 138, 348; 8, 81; 11, 411, 749; 12, 185, 206; 13, 42, 663; 16, 367; Paus. 2, 27; 8, 18; Iren. (Patr. Gr. 5, 1388 A; 7, 440); Luc. Ver. Narrat. ex ὕαλου. Idem, de Luctu, 21; Quomodo Hist. Conscr. 25; Alex. Aphrod. on Arist. de Anima, 133, 18; 138, 28; 149, 28. Idem, Problem. 1, 61; 2, 39; Pollux, 3, 87; 6, 14 (in mss. C.V.); P. Fay. 134, 4; Caesar Dial. 1, 68 (Patr. Gr. 38, 936); Orib. 2, 711, 15, 1; 9, 550, 5 (from Galen) Orion: ὕαλη· ὕαλος. Hesych. λογόγραφον· ὕαλος. δάλη· ὕαλος. ὕαλος· ὕελος. Aen. Gaz. 552, 71; Damascius, Dub. et Solut. 1, 183, 11; Aen. Tat. 2, 3; Rufinus (Anth. Pal. 5, 36; 48; Andreas

and hyelos,¹ then continue side by side, and the same is true of

Caesar (Patr. Gr. 106, 433, 437); David Armen. Proleg. et in Porphyr. Isagog. 20, 11; Schol. on Plato's Alcibiades, 132 E; Olympiodorus on Plato's Alcibiades 2, 223, ὕαλο κέρας is an error for ὕαλον ἢ κέρας. See Comm. by Creuzer, note 53; Thes. Gr. Ling. 8, 7. Paul. Aeg. 84, 2; 117^v, 42; Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 444, 12; R. Brian, Chirurgie, 142; Theognostus, Canon. 18, 29; Photius, Bibl. 275 (Patr. Gr. 104, 244 A); Schol on Clem. Alex. Paedog. 180, 28. For the dialectic form ὕαλοιο (gen.) see Suid. under ἐνδιος and οὐριαχος. Psellus, Carm. de Re Med. 596; Zonaras, Lex. 1665, 1759; Nicephorus Blemm. Epitome Log. (Patr. Gr. 142, 697, 18 C; Lyhistrus and Rhodamne, Phlorius and Platziaflora (Konstantinides, Μεγαλέξικον under ὕαλο-).

¹Hedylos in Athen. 11, 486 B or Anthol. Gr. Append. 1, no. 115; Hero, Pneumat. 2, 4; Definitiones, 4, 102, 16; 106, 3, 10. In the latter ὕαλος C. Diod. 2, 15, 1, 2, 4. Joseph Bell. Iud. 2, 10, 2: "ὕελον"] PAML² ὕαλον (a ex corr. V) L¹ VR ὕαλλον C. Plut. Quaest. Conv. 3, 19, 3; Galen. 13, 290; 16, 585; 19, 695; Mesomedes (Anth. Pal. 16, 323); Luc. Amores, 26; Alex. Aphrod. on Arist. de Anima, 142, 28; Met. 588, 40; Idem, Problem. 1, 119, 120; 2, 4; Clem. Alex. Paedog. 2, 3, 35; 12, 118; Philostratus, Vita Ap. 3, 1; Epist. 242, 21; P. Holm. i. 5; Ps. Callisthenes, 2, 18, 38; Athan. (Patr. Gr. 28, 789 B); Apsyrtus (Hippiatr. 2, 82); Orib. 5, 66, 1; Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 569; Titus Bostrensis (Patr. Gr. 18, 1193 C); Theodoretus (Patr. Gr. 83, 617 A); Steph. Alex. De Magna et Sacra Arte, 3; Hesych. s.v. ὕελος ὕαλος. Λογούριον ὕελος. Λάκωνες. Orion: ὕελός [sic]; Anaphora Pilati 2 (C. Tischendorf, Evang. Apoc. 422); Philoponus on Arist. de Anima 2, 6, 7; Meteor. A, 3, 5; G. Hirschberg, Die Augenheilkunde des Aetius von Amida 1, 25; Alex. Trall. (Daremberg-Ruelle, Oeuvres de Rufus d' Ephèse, 95); Excerpta ex commentar. Alexandri et Olympiodori (Ideler, 29). Photius: ἡλεκτρον ἀλλότυπον χρυσίον μεμιγμένον ὕελω καὶ λιθία.

The spelling must be due to the copyist for Photius says elsewhere that hyalos and not hyelos should be used. Photius Patr. Constant (Patr. Gr. 101, 277 A); Meletius (Patr. Gr. 64, 1168 B ff); Bachmann, Aneod. Gr. 1, 250, 4; Leo. Philos. Conspectus. Medic. 3, 1, 129; Suid. s.v. διαφανές and ἡλεκτρον; Geopon. 5, 7, 2; 9, 19, 10; Abitan. de Urinis, 296, 20; Psellus, de Lapid. 1, 25; Etym. Gud. 78, 240; Schol. on Aristoph. Nub. 768; Etym. Magn. s.v. ἀλάραστρον and ἡλεκτρον; Zonaras, Lex. s.v. ἡλεκτρον; Eustratius on Aristot. Analy. Post. 151, 21 ff. (ὕαλος et ὕαλον in ms. e); Demetrius, Hieracosoph. 26, 271, 281, 283; Joan. Actuarius, de Urinis. II, 32, 21; 33, 12; Nemes, de Natura Hominis (Patr. Gr. 40, 645 B).

the compounds and derivatives. Herodian¹ in his work on orthography puts hyalos first as the preferred form, which is what would be inferred, at least, from its more frequent occurrence up to this time, and because it seems to have been the older form. Phrynichus² and the later grammarians³ insist that the spelling with alpha is the only correct one, while a certain Polybius, of whom practically

¹Herod. Tech. Reliquiae (ed. A. Lenz), 2, 595, 15: ὕαλος· ὕελος.

²I. De Borries, Phryn. Praepar. Soph. 118: ὕάλινα καὶ ὕαλος· διὰ τοῦ ᾱ, οὐ διὰ τοῦ εῖ. C. Lobeck, Phryn. 309: ψίεθος, μιερός, ὕελος, ἀμαρτάνουσιν οἱ διὰ τοῦ εῖ λέγοντες. ἀδόκιμον γάρ. καὶ Κορίννα τὸν θάλινον παῖδα θήσεις. ὁ πύελος διὰ τοῦ εῖ, καὶ μυελὸς ρητέον.

"Primum articulum Edd. Pr. V et Phav. ommittunt. . . Secundum articulum ed. Pr. hoc modo scriptum exhibet: πύελος, μυελός, ὕελος ρητέον. ἀμαρτάνουσι γὰρ οἱ μὴ διὰ τοῦ εῖ λέγοντες, ἀλλὰ διὰ τοῦ ᾱ. In oculos incurrit, haec non ab eodem Phrynicho scribi potuisse. ὕαλος non ὕελος dicendum esse, uno ore tradunt Phrynichus App. p. 68. Dionysius Atticista, Photius, alii. v. Sallier p. 373. Neque Theophrasti auctoritas, quam ille praetexit, tanta videri debet, ut grammaticorum sententiae, Aristophanis et Platonis testamentio communitae, idcirco abrogemus." W. Rutherford, The New Phryn. 281: ψίεθος... θήσεις. "This article is not found in any of the manuscripts in the editions of Callierges or Vascosan, or in Phavorinus; but the first Laurentian manuscript and the first editor include ὕελος in the next article. Much of this part of the book is undeniably spurious."

³Photius: ὕαλος· διὰ τοῦ ᾱ· οὐχὶ ὕελος· καὶ θηλυκῶς ἢ ὕαλος· καὶ ὕάλινον· Ἀριστοφάνης Ἀχαρνεύσιν· ἐξ ὕαλινων ποτηρίων καὶ χρυσίδων· πάντα δὲ τὰ τοιαῦτα διὰ τοῦ ᾱ λέγονται. Bachmann, Anecd. Gr. I, 392 ff.: ὕαλος· διὰ τοῦ ᾱ· οὐχὶ ὕελος· καὶ θηλυκῶς ἢ ὕαλος· καὶ ὕάλινον Ἀριστοφάνης Ἀχαρνεύσιν· ἐξ ὕαλινων ποτηρίων καὶ χρυσίδων. Bekker, Anecd. Gr. I, 68, 22: ὕάλινα καὶ ὕαλος· διὰ τοῦ ᾱ, οὐ διὰ τοῦ εῖ. Schol. on Aristoph. Nub.

768 (Dübner 116): ὅτι δὲ ὕαλος θηλυκῶς, καὶ διὰ τοῦ ᾱ. Zonaras, Lex. 1759: καὶ τὴν ὕαλον θηλυκῶς ἐν τῷ ἄλφα λεκτέον, οὐχὶ ἐν τῷ εῖ. Etym. Magn. 774, 3 ff.: ὕαλος· διὰ τοῦ ᾱ, οὐχὶ ὕελος καὶ θηλυκῶς, ἢ ὕαλος. Miller, Melanges de Lit. Grec. Etym. Mag. (Flor. Ms. 304) 290: ὕαλος, 774, 4: καὶ ὕάλινον Ἀριστοφάνης ἐν Ἀχαρνεύσιν (v. 74 ubi ἐκ πυράτων καὶ χρυσίδων) ἐξ ὕαλινων ποτηρίων καὶ χρυσίδων· πάντα δὲ διὰ τοῦ ᾱ λέγεται.

Ps. Philemon, Lex. 171 (A forgery probably written by J. Diassarinus according to K. Krumbacher, Gesch. d. byzant. Lit. ed. 2): ὕαλος· παρ' Ἀττικοῖς, ὁ ὕελος· καὶ ὕαλοεν, διαφανές. Ἀριστοφάνης τὴν ὕαλον λέγει· ὅπερ κατασκευασμὰ ἐστὶν ὕαλου τροχοειδὲς παχύ, ἐφ' ᾧ χέοντες ἔλαιον, καὶ χρίοντες αὐτό, καὶ θερμαίνοντες, προσάγουσι θρυαλλίδα· καὶ οὕτως ἐπτοῦσιν· ὅτι δὲ ὕαλος θηλυκῶς καὶ διὰ τοῦ ᾱ, φανερόν παρ' Ἀττικοῖς. Ὅμηρος δὲ τὸ ὄνομα οὐκ εἶπεν, ἀλλὰ παρ' αὐτῷ καὶ τοῖς ἀρχαίοις ἡλεκτρός ἐστὶν, ὕαλος δὲ οὐ. Note 248, "Similia Phavorinus h.v.p. 1789.1."

nothing is known, even lists hyelos as a barbarism,¹ which is surely going too far. The grammarians no doubt merely mean that hyalos is the Attic form and hyelos the Hellenistic, as, indeed, it is once expressed by Moeris² and Thomas Magister.³ This is only partly true, for although hyalos is Attic, it is also Boeotian⁴ and Ionic.⁵ It is, therefore, probably just the older form. There are a few other words which have similar alternate forms, the origin of the second one of which is often unknown.⁶ It has been suggested that hyelos is produced by a weakening of the alpha,⁷ or that it is an Ionic form⁸ admitted by late Atticists.⁹ Hyalos also sur-

¹Polyb. de Barbarismo et Soloecismo (Nauck, Lex. Vindob. 284):
περὶ δ' ἐναλλαγῆν γίνεται βαρβαρισμὸς περὶ τὰς προσώδιας, καὶ ὅταν ἕτερα ἀντ'
ἑτέρων λαμβάνηται γράμματα ὅσον εἴ τις λέγοι φιέλην τὴν φιάλην καὶ ὕελον τὴν ὕαλον.
The ms. here (see Boissonade, Anecd. Gr. 3, 230) gives φιέ φιάλην
καὶ ὕελον τὴν ὕαλτε. All that can be said of the date of
Polybius is that his work appeared in a manuscript of 1496. See
Boissonade, 229.

²Moeris, Attic. Lex. 275: ὕαλος, ἐν τῷ ᾧ Ἀττικῶς. ἐν τῷ ἑ, Ἑλληνικῶς.
Sallier on Moeris, 275: "Ita Lucianus, qui ut et Theophrastus,
ὕελοσt. 1. p.1004, scribere non dubitavit. τὸ δ' ἄλλοσῶμα, inquit,
μηδ' ἀκαρῆ τριχὸς αὐταῖς ὑποφωμένῃς ἡλέκτρον φασὶν ἢ
ξιδωνίας ὕελου διαφεγγέστρον ἀπαστράπτει. Quod si ὕαλος etiam in eiusdem
scriptis occurrit, ex eo illud tantum sequitur, nomen ὕαλος et
ὕελος nullo discrimine ab Atticis usurpatum." Thes. Gr. Ling. 8, 9.

³Thom. Mag. 365, 1 ff.: ὕαλος Ἀττικοί. Ἀριστοφάνης ἐν νεφέλαις τὴν
ὕαλον λέγει. ὕελος δὲ ἅπλως Ἕλληνες. See G. Meyer, Gr. Gram. ed. 3, 159;
F. Blass, Gram. d. N. Test. 21.

⁴See Corinna in Phryn. 309.

⁵See Hdt. 3, 24.

⁶Brugmann, Grundriss, 2, 174; Schweizer, Gram. der pergamen.
Inscr. 36.

⁷W. Schmid, Der Atticismus, 4, 683.

⁸Smyth, The Greek Dialects, 140: "Forms in -ελοσ in the κοινή were
once held to be Ionic, perhaps, because of Hom. πύελοσ μυελός,
later πύαλοσ μυαλός. A. Thumb, D. Gr. Sprache im Zeitalter des
Hellenismus, ed. 2, 75; Blass-Debrunner, Gram. d. N. Test. ed. 4, 29

⁹W. Schmid, op. cit. 4, 580: "Vulgarismus . . . welche aber
möglicherweise als Ionismen passierten."

vived in popular speech along with hyelos, as is shown by its use in literature which made no pretense to Atticism, such as the New Testament,¹ its appearance in papyri,² and its survival in modern Greek.³

b. Hyalos (hyelos) the adjective.-- Hyalos⁴ (hyelos)⁵ sometimes occurs as an adjective of three terminations. The Etymologicum Magnum gives hyalinus as preferable to hyalos,⁶ and this statement is, of course, correct if one judges by standards of frequency of occurrence. It has been suggested that hyalos here may be an error for hyalous,⁷ but, despite the fact that other lexica in much the same connection speak of hyalous, there is no doubt that hyalos also was used as an adjective, and such a correc-

¹ Kühner-Blass, Gr. Gram. 1, ed. 3, 117; E. Schweizer, Gram. der pergamen. Inschr. 36; A. Thumb D. Gr. Sprache im Zeitalter. des Hellenismus, ed. 2, 18, 76.

² See note 5, page 34.

³ S. Koumanoudes, Synag. Neon Lex. 2, 1021 ff., 1030; A. Kyriakides, Mod. Gr.-Eng. Dict. ed. 2, 784 ff., 787. On the development of Yali see A. Jannaris, An Hist. Gr. Gram. 151; G. Chatzidakis, Gloss. Melet. 1, 222; G. Cousin, Etudes de Géog. anc. 254.

⁴ Lucian, Quomodo Hist. Conscr. sit. 25, (where, according to Sommerbrodt, the following variants occur, "ὑάλα Marc. 434, Vatic. 90. ὑάλα Harl. ὑάλλα Vatic. 87", which, although in correct readings for Lucian, do yet when combined with other evidence attest the existence of these as possible forms. P. Ox. 13, 10, 1294, 6: ὑάλαι λάγυνοι δ' ὑγείαι.

⁵ Galen, 14, 409: ἐν ὑέλω ἀγγείῳ. Ps. Callisthenes, 2, 38, 7: ἐν τῷ ὑέλω πίθῳ. Paul. Aeg. 35, 10: ἐν δέλω ἀγγείῳ.

⁶ Etym. Magn. 774, 3: καὶ ὑάλινον, ἀντὶ τοῦ ὑάλου. Cf. Miller, Mélanges, 290: ὅθεν καὶ ὑάλινα ἀντὶ τοῦ ἕλα (ὑάλα?).

⁷ "Pro ὕκλον sententia requiritur potius ὕαλον, vitreum," wrote Sylberg, unaware apparently of this employment of ὑάλος -η -ον as an adjective.

tion here would be nothing less than the destruction of evidence. Finally it should be noted that among the Romans hyalos was also glossed by vitreus.¹ In every case the significance is 'made of glass,' but Hesychius² also gives the derived meaning 'bright.'

c. Hyallos (hyellos).-- In late Greek a spelling with with double l, i.e., hyallos and hyellos sometimes appears.³ It is impossible to say at just what time this spelling begins, but the manuscripts in which these forms occur (in so far as I could find any indication of their age) range from the eleventh to the four-

¹Corp. Gloss. Lat. vitrum vitreus ὕαλος; vitreum ὕελος.

²Hesych. ὕαλόν· λαμπρόν. Schmidt, "In cod. ὕαλόν scriptam malui in ὕαλοῦν mutare, quam cum Thes. in ὕαλόεν." See Thes. Gr. Ling. 8, 7, s.v. ὕαλός. There seems to me no need for changing the manuscript reading.

³Hdt. 3, 24: ἐξ ὕαλλον V' (S.XIV); Aristot. Meteor. 4, 10, 389 A, 8: "ὕελος Brec. F corr. m.1." (B. S. XII, F.S.XIV); Strabo, 17, 2, 3: ὕαλλον F (S, XIV); Joseph. Bell. Iud. 2, 10, 2: ὕαλλον C (S.XI); Herodian, Epim. 138: ὕελος· ὕελλοψές. Note ὕελος "quod sequitur sic per duplex λ scriptum est in Lexico π. πνευ. p.236," Boissonade. Luc. Ver. Hist. 2, 11: ὕελλινος Vatic. 87 (Sommerbrodt), N (Nils Nilén); Id. Quomodo Hist. Conscr. 25, ὕαλλα, ὕαλλου Vatic. 87. Alex. Aphrod. on Aristot. Met. 588, 40: ὕελλον AL (S. XIII); Ps. Callisthenes (ed. Meus) 2, 38: ὕελλινος (quoted from Crönert, Memoria Gr. Herculanensis, 75, 7); Hesych. s.v. ἀΐτυρον· ὕαλον Ald. (1514) ὕαλλον. Ibid. ἐνβενος· ὕελλοειδής. [ἐνβεννοειδής· ὕελλοΐδης(σι)C]; Ibid. κρόσταλλος· εἶδος ὕελλου. Schmidt, "Dialectus est Cypria. ὕελλον cod., em. Palmer." Alex. Aphrod. Probl. 1 132 (ed. Ideler, 1, 45): διὰ τί τὰ ὕελινα κάτοπτρα λάμπουσιν ἄγαν, ὅτι ἐνδοθεν αὐτῶν χρίουσι κασιτέρῳ πέφενκε δ' αὐτοῦ ἡ φύσις διαυγῆς καὶ τῇ ὕελλῳ ἀναμιγνυμένη λαμπρὰ οὖσα πλέον διαυγάζεται, καὶ τὰς ἰσίδας ἀκτῖνας διὰ τῶν πόρων τῆς ὕελλου παραπέμπουσα διπλασιάζει τὸ ἐπὶ πολλῆς καὶ ἐκτὸς τοῦ σώματος τῆς ὕελλου· καὶ οὕτως γίνεται σφόδρα λάμπουσα. Olympiod. on Arist. Meteor. IV (ed. Ideler, 2, 228): Ald. ὕελλέψαις Ideler quotes Hesych. ὕελλέψεις· ὕελοτέχνηαι, but there is no indication in the Schmidt edition of a double l in this passage. J. Nicole, Le livre du préfet, 71 (Cod. Jul. Ascal.), 19. Title - περὶ ὕελλουργῶν καὶ τῶν ὁμοίων. T. I: ὕελλουργοὺς Gen. ms. 23 ζ (S.XIV). Suid. ἤλεκρον· ἀλλότυπον χρυσίον, περιγυρόμενον ὕελλῳ καὶ λιθίᾳ. Ms. E ὕελλῳ. Zonaras. 1043: ὕελλινον. 1665: ὕελλος A. Georg Lacapen de Syntaxi, 114: ὥσπερ γὰρ ὁ ἥλιος διὰ μέσου ὕελλου, ἢ ὕδατος τὰς ἀκτῖνας ἐκπέμπει τὸ ψῶς (Quoted from Du Cange).

teenth century, and the double l is used in some of the Aldine editions also (see preceding note), so that this must have been a vulgar spelling which had grown pretty common by the fifteenth century, but is not attested by papyri or inscriptions and hence is probably Byzantine in origin.

d. Hyalê.-- Like a few other nouns (e.g., chonos-nê, tylos-lê, etc.),¹ the word for glass, according to the lexicographers,² was also heteroclitic, i.e., hyalos and hyale. The latter form, however, occurs very seldom outside of the lexica. In two manuscripts of Suidas, where he is quoting Antiphrilos, hyalês is used instead of hyalou.³ An interpolation in the text of Dioscorides⁴ contains the word hyalê, but the accent falls upon the

¹Lobeck, Pathol. Proleg. 7 ff.

²Orion (Sturz); Photius; Bachmann: Anecd. Gr. 1, 393; Suidas; Etym. Gud. (Sturz, 538): ὑάλη· ὕαλος. Hesychius also defines hyalê as hyalos but he gives it the further meaning of a 'worm.' ὑάλη· ὕαλος· βόμβυξ· σκώληξ. Similarly, ὑάλεται· σκωληκιᾶ. Elsewhere εὐλή is defined as a worm. εὐλάζει· καπρᾶ· σκωληκιᾶ· | εὐλαῖ· οἱ ἐν τοῖς τράυμασι γινόμενοι σκώληκες· | εὐλάς· σκώληκας· | εὐλέων· σκωλήκων. From this it has been conjectured that ὑάλη and ὑάλεται are probably dialectic forms for εὐλή and εὐλάζει. Thes. Gr. Ling. 8, 7, s.v. ὑάλομαι. "Fortasse alicubi ὑάλεται pro εὐλαῖται et ὑάλη pro εὐλή corrupte scriptum reperit. Supra: εὐλάζει· σκωληκιᾶ Ruhnck." See Curtius, Gr. Etym. ed. 5, 564: "While the stem εὐλα with prefixed é stands for é-φλα, in ὑαλα the initial F survives in the form of υ... ὑαλεται, however, is no denominative like σκωληκιᾶν· εὐλάζειν... but must be regarded as a primitive verb in the sense of 'swarms'."

³Suidas, s.v. νάρδος... νάρδον, ὑπὸ γλαυκῆς κλειομένην ὑάλου (ὑάλους reading of mss. B E).

⁴Interpolator of Dioscorides, I, Parabil. 170 (ed. of Venice 1518): βαλὼν αὐτὸ εἰς ὑαλὴν, καὶ κρέμασον εἰς ἥλιον ἡμέρας δ'. These interpolations date from the period between Galen and Oribasius (Wellmann in P.-W. 5, 1141, 9 ff.).

last syllable, a thing which happens very rarely with hyalos (hyelos). It is possible that the hyalê (oxytone) of the Interpolator is not just the same as the hyalê (paroxytone), which the lexica define as 'glass,' but some special kind of a glass vessel. Yet those who define it as a 'vial'¹ or a 'glass vessel'² do not explain its accent, but consider it the same as the hyalê with the ordinary accent, i.e., paroxytone. In that case there is no reason to give it any further definition than that of the lexica, simply 'glass.' The Greeks used hyalos (hyelos) for a glass vessel or something made of glass. The physicians³ especially speak of putting a medicine 'in' or 'into a glass' without any specification as to the nature of the vessel. The use of hyalê (oxytone) by the Interpolator of Dioscorides seems very similar. Of course this may have been a vial, and so might the nard-glass of Antiphilus, but since the word vial is not derived from hyalê and there is nothing in the context to throw light upon the shape of the vessel, except that it is likely to have been of small or moderate size, any opinion is nothing more than a guess. Then, in spite of the accent which occurs so seldom on hyalos, it seems probable that hyalê (oxytone) is the same as the hyalê (paroxytone) defined as hyalos

¹ DuCange, Gloss. Med. et Inf. Gr. 2, ὑάλη: "vas vitreum colli angustioris, nostris inde Firole," quoting the interpolator of Dioscorides, 1, Parabil. 170. Since firole is derived from L. phiala, Gr. φιάλη (see Skeat, An Etym. Dict. of the Eng. Lang. 690), there is no etymological evidence for this interpretation.

² Thes. Gr. Ling. 8, 9. Perpl. Maris Er... λιθίας ὑαλῆς πλείονα γένη. "Interpr. Omnis generis vasa vitrea," but this is clearly the adjective and not a noun, and hence does not belong here.

³ Galen. 13, 42, 290; Orib. (Daremborg-Ruelle, Oeuvres de Rufus d'Éphèse, 569).

in the lexicons and when used alone for a glass object, it is to be interpreted according to the context.

e. Proper Nouns.-- Among the nymphs of Diana there was one by the name of Hyalê,¹ the 'glassy-bright,' a designation which probably suggests the bright, clear water of mountain springs.²

In a list of Athenian Ephebi, as given by Boeckh,³ the name Loukios Hyalos occurs. Keil⁴ thought this was very doubtful and proposed Hyllos,⁵ but there is no doubt of the readings of the inscription,⁶ and, in view of Hyalê (above), the name seems to be a possible one.

f. Hyalas.-- The form hyalas occurs in a Greek papyrus in the British Museum.⁷ Kenyon thinks the termination is irregular and lists it in the index under hyalos. It is very unlikely, however, that this has anything to do with glass, but by

¹Ovid, Metam. 3, 171.

²Of course Hyelê, the old name for Elea (Strabo, 6, 1, 1; Herod. Tech. Reliquiae, 1, 284, 23; Diog. Laert. 9, 28), a town in Lucania, has nothing to do with hyalos. It represents the Latin Velia, the upsilon standing for the Latin V or W sound (W. Schulze in Kuhns. Zeitschr. 23, 396; P. Kretschmer in Wiener Eranos, 1909, 120).

³**CIG I 286: ΛΟΥΚΙΟΣ ΥΑΛΟΣ = IG III 1161, 21.**

⁴Keil, Spec. Onom. Gr. 77.

⁵Hyelos (Pape-Benseler s.v. Υελος) occurs as an error for Euryale, the mother of Orion. See Schneider, Nicandrea-Theriaca et Alexipharmaca, 5, 26: Ἡσίος δὲ φησιν αὐτὸν ἐξ Εὐρύαλης τῆς Μίνως θυγατρὸς εἶναι καὶ Ποσειδῶνος. Note on Ἡσίος: "cf. schol. Arat. phaen. 322 Eratosth. catast. 32 Εὐρύαλης Eratosthenes l.c. Apollod. 14, 3 Ἑέλου ΚΑ".

⁶It is in the Louvre, no. 140 in Froehner's Inscr. Grecques du Musée du Louvre.

⁷P. Lond. 2, 402, 13: ποτηριον υαλας (sic).

folk etymology it probably arises from gyalas,¹ a special kind of cup mentioned by Athenaeus.²

4. Simple Derivatives: (a) Hoialas.-- A curious form hoiala occurs among the Christian sepulchral inscriptions. It has been plausibly interpreted as a vulgar variant for hyala, that is, the genitive singular of *hyalas, to indicate a worker in glass.³

(b) [Hyaleis].-- See below note 4.

(c) Hvaleos (hyeleos).-- Neither hyaleos⁴ nor the contracted form, hyalous⁵ (hyelous),⁶ occurs before the time of Strabo. The uncontracted form is rare, but the use of hyalous is fairly

¹U. Wilcken (Archiv für Papyrusf. 1, 135); Herwerden, Lex. Gr. Supp. et Dialect. s.v. ὑάλας; Mayser, Gram. d. gr. Pap. 164.

²Athen. 1, 31: ΓΥΑΛΑΣ. Φιλητᾶς ἐν Ἀτάκτοις Μεγαρέας οὕτω φησὶ καλεῖν τὰ ποτήρια, γυάλας. Παρθένιος δ' ὁ τοῦ Διονυσίου ἐν α' περὶ τῶν παρὰ τοῖς ἱστορικοῖς λέξεων ζητοῦμένων φησὶ· γυάλας ποτηρίου εἶδος, ὡς Μαρσύας γράφει ὁ ἱερεὺς τοῦ Ἡρακλέους οὕτως· ὁ τὰν εἰσὶν ὁ βασιλεὺς εἰς τὴν πόλιν, ὑπαντᾶν οἴνου πλήρη γυάλαν ἔχοντά τινα, τὸν δὲ λαβόντα σπένδειν·

³Bayet (Bull. de Corr Hellén. 2, 166, n. 62); I G III 3436: Κυρηνητῆριον Εὐφρασείου οἶαλα κε Γενναδίας.

⁴Strato (Anth. Pal. 12, 249); Maecius (Anth. Pal. 6, 33), of uncertain date, as well as the following. C. Wessely, Corp. Papyr. Hermopolitan. (Stud. zur Pal. u. Papyruskunde, 5, 9, 6): καὶ σκεύη ποικίλα ὑέ[λεα]. Hesych. ὑάλε(ο)ν. "ad h. l. ὑαλέν non erat ὑαλόεν corrigendum cum Thes., sed ὑάλεον (hoc accentu, Lob. Path. Prol. 101) quod ordo poscit," Schmidt.

⁵Strabo, 4, 5, 3; Damocrat. in Galen, 14, 99, 5; Peripl. Maris Erythr. 6, 7, 17, 39; Dio Cassius, 57, 21, 7; Luc. Quomodo Hist. Conscr. sit, 25: ὑάλινα (ὑάλα ΩΓ ὑαλα Harl." Sommerbrodt) Hippolytus, Elenchos, 2, 235, 2; Hesych. s.v. Τριόπιος and ὑαλοῦν.

⁶P. Lond. 2, 191; Soranus (Idalex, 1, 248); Galen, 13, 41; 54; 97; 98; 1056; 1057; Hippolochus in Athen. 4, 129 D; Clemens Alex. Paedog. 2, 4, 39; P. Fay. 104, 1, 2; Pollux, 6, 14: ὑάλου CV. ὑελοῦν CA; Orib. 1, 384; 2, 60 (from Antyllus), 62, 64; 4, 630; Paul. Aeg. 26, 27; 121, 12; 132, 1; Geop. 9, 19, 9.

common, although not so much so as hyalinus, for which the grammarians¹ express a preference above other adjectives of a similar meaning. Hyaleos usually has the significance 'of glass,' 'made of glass,' but it also sometimes means 'bright,' 'smooth,' 'transparent,' or 'like glass.'² It is used in describing the cheek of a boy,³ and eyes,⁴

(d) [Hyalês].-- See below note 3, page 45.

(e) [Hyalieus].-- See below note 2, page 45.

(f) Hyalizô (hyelizô).-- The present participle of hyalizein, 'to be like glass,' is employed to describe resin,⁵ gums,⁶ the slag of lead,⁷ and gems.⁸ Hesychius uses it in defining hyale(o)n.⁹ The resin is said to be 'like glass in color.' This

¹Photius (Porson): ὑάλινον· ἀντὶ τοῦ ὑαλᾶ. "Accent om. m. pr. ὑάλα voluit corrector, ni fallor." Zonar. 1759: ὑάλινον, οὐχὶ ὑαλου. See note 7, page 38.

²Hesych. ὑάλε(ο)ν· λαμπρόν, ὑαλίχον. See Thes. s.v. ὑαλόεις. Ibid. ὑαλο(ῶ)ν· λαμπρόν· πρᾶον. "In cod. ὑαλόν scriptam, malui in ὑαλοῦν mutare, quam cum Thes. in ὑαλόεν," Schmidt. πρᾶον seems to be misplaced, as it makes no sense here. I should retain the manuscript reading, see above, page 38.

³Strato (Anth. Pal. 12, 249): ρουποίητε μέλισσα, πόθεν μέλι τοῦ ῥόν ἰδοῦσα παιδὸς ἐφ' ὑαλέην ὄψιν ὑπερπέτασαι. Paton translates this "smooth as glass." Since transparency is the chief characteristic of glass, when a complexion is said to be like glass, it also suggests a fair, clear complexion.

⁴Hesych. s.v. τριοπίς· τριόψθαλμος. ἐνιοὶ γῶον δμοιον ἀκρίδι καὶ περὶ τραχήλιον τρεῖς ἔχον ὀφθαλμοὺς ὑαλοῦς. "Denique ὑαλοῦς cod., ὑαλου Salmas., ὑαλίλους Sopingus em. Lob. Phrynich. 309."

⁵Dioscorides, 1, 91: de Terebintho: ἡ δὲ καὶ διαφέρει διαυγεστέρα οἷα, λευκὴ, ὑαλίχουσα τῷ χρώματι καὶ κυανίχουσα, εὐώδης, θερμὴν θοὴν πνέουσα.

⁶Ibid. 1, 133, de Acacia: τὸ δὲ κόμμι τῆς ἀκάνθης διαφέρει τὸ σκληροειδές, ὑαλίχον, διαυγές, ἄξυλον, εἶτα τὸ λευκόν. Compare Orib. 5, 72, 10.

⁷Dioscorides, 5, 97: de Scoria Plumbi: σκωρία μόλυβδου ἀρίστη ἐστὶν ἡ ψευθοφανής, πυκνὰ καὶ δύσθραυστος, μηδὲν ἔχουσα μόλυβδῶδες, ρυθινοειδὲς τῷ χρώματι καὶ ὑαλίχουσα.

⁸Psellus, de Lap. 1, 2: ὁ ἄδαμας· χροῖαν μὲν οὗτος ἔχει ὑαλίχουσαν καὶ στιλπνὴν.

⁹Hsych. s.v. ὑάλε(ο)ν. See above note 2.

raises the question what 'glass-colored' means.¹ Resin is a clear yellowish substance. The only characteristic which glass and resin have in common is transparency, which although not technically a color, seems to be the meaning of 'like glass in color' in this instance, at least.

(g) [Hyalîês] .-- Hyalîês occurs in Hesychius² in a corrupt passage, which is copied by later lexicographers.³ Since hyaneos⁴ is defined exactly as hyaliês, doubtless the Λ of the latter is a paleographic error for \mathbf{N} , as suggested by Schmidt.⁵

(h) [Hyalikos] .-- See below note 7, page 47 f.

(i) Hyalinos (hyelinos)-- The adjectival form, hyalinos, occurs in literature before hyalos. In supporting his preference for a rather than e in the word hyalos Phrynichus⁶ mentions the use of hyalinos by Corinna. This passage is extremely obscure, however, and although attempts to emend the word are certainly not justified, nothing can be learned about glass from the expression

¹See below, page 56.

²Hesych. ὑαλίνης ἢ ὑαλίεος· εἰκατος· βλοσυρός.

³Theognostos, Canones, 18, 29: ὑαλίνης εἰκατος, βλοσυρός.
Cf. Zonar. 1759: ὑαλῆς· εἰκατος· βλοσυλός.

⁴Hesych. ὑανέος· εἰκατος· βλοσυρός.

⁵Hesych. (ed. Schmidt), note on ὑαλίνης. See Curtius, Gr. Etym. ed. 5, 565.

⁶Phryn. 309: καὶ ἡ Κόριννα τὸν ὑάλινον παῖδα θύσεις.
There have been numerous conjectures concerning this passage, for which see Lobeck on Phryn. 309, note a; Th. Bergk, Poet. Lyr. Gr. 3, frag. 42. Once in a while hyalinos does mean 'glass-like,' and since skin is sometimes compared with glass because of its brightness, smoothness, or transparency, it is possible that ὑάλινον παῖδα means a child with a clear, smooth complexion.

which is quoted. Aristophanes¹ is the first to speak of a vessel made of glass, and it is partly on his use of hyalinos that later grammarians base their preference for the spelling with a.²

Hyalinos³ was used over three centuries before hyelinos, which does not occur until the second century before Christ, more than a hundred years after hyelos. But from then on hyalinos⁴ and hyelinos⁵ are used with about the same degree of frequency. Occa-

¹Ach. 74: ἐξ υἰαλίνων ἐκπωμάτων. Quoted in Pollux. 6, 100: Ἀριστοφάνης δὲ πού ἐφη Ἐπίνουμεν ἐξ υἰαλίνων ἐκπωμάτων. 10, 68: ἐν δὲ Ἀχαρνέσιν Ἀριστοφάνους ἐξ υἰαλίνων ἐκπωμάτων καὶ χρυσίδων.

²Photius, s.v. υἰαλος; Bachmann, Anecd. Gr. 1, 392 ff.; Miller, Mélanges, 290.

³I G II 646, 4: υἰαλίνου ἀργυροῦν, σταθμῶν [FIII]; I G II 652 R; I G II 656, 18: υἰαλίνον ἀργυροῦν, σταθμῶν τούτου FIII; I G II 682; IV 672 c; P. Flind. Petr. III 42 H, 73: υἰαλίνην γενέσθαι καὶ ῥυτὸν τριτῶν.]

⁴Hero, Pneumat. 1, 14, 214, 222, 234; Idem, Dioptric. 3, 200; Philodemus, de Morte, 39, 1 ff.; Strabo, 17, 1, 8; Hippocrates, Epist. 16 (ed. Kuhn, 23, 792); Rev. 4, 6; 15, 2; Damocrat. (in Galen 14, 99, 5); Epictetus, 3, 24, 84; Galen, 5, 838; 11, 875; 12, 490; 14, 48, 268, 392; Ael. Promotus (Wellmann, Corp. Med. Gr. 10, 1, 1, 9); Lucian, Ver. Hist. 1, 25, 27, 42; 2, 11, 14; Idem, Quomodo Hist. Conscrib. sit, 25; Paus. 2, 27, 3; Philumenus, de Venenatis Animal. 4, 15, ms. P has υἰατι corrected to υἰαλίνω by Wellmann from Aelius Promotus, περὶ ἰοβόλων θηρίων (Corp. Med. Gr. 10, 1, 1, 9, 91); Athen. 5, 119 F; Ps. Callisthenes, 3, 31; Inscr. of Cos. (Paton-Hicks), 36; Hesych. s.v. υἰαλος; Damascius (Patr. Gr. 103, 1289 A); Paul Aeg. 87, 4; 126, 24; Id. Chirurgie, 348, 368; Theognostus, Can. 18, 29. The latter is an error probably caused by copying a corrupt passage in Hesychius. Bachmann, Anecd. Gr. 1, 256, 17; Suid. s.v. θηρίκλειον; Hippiatr. 1, 46, 48; Zonar. Lex. 1759; Etym. Magn. 774; Anthol. Pal. 14, 52 (of uncertain date).

⁵Hero, Pneumat. 1, 8, 234, 236, 238, 240, 242; Dioscorides, 5, 110; Joseph. Bell. Ind. 2, 10, 2; Aelian, Var. Hist. 13, 3; Galen, 12, 631, 637, 660, 827; 13, 30, 56, 104, 746, 1010, 1045; 14, 293, 403, 406, 539, 568; Script. de Rebus Alex. (K. Müller, Ps. Callisth. 2, 38, 4); Athanasius (Patr. Gr. 28, 789 B); Basil. Homil. 6 (Patr. Gr. 31, 1473 D); Oribasius (Bussemaker-Daremborg 5, 199, 11); Titus Bost. Adv. Manichaeos, 2, 31 (Patr. Gr. 18, 1193 C); Cyril. Gloss (Hesych. ed. Schmidt, 4, 341); Alex. Aphr. Probl. 1, 132 (Ideler, 1, 45); Aetius, 1, 7 (Patr. Gr. 157, 164 or Scr. Hist. Byz. 37, 149); Philoponuson Arist. de Anima, 320, 351, 429; on Arist. Meteor. 49; Paul. Aeg. 2, 3; 26, 21; 137; Photius (ed. Porson) s.v. θηρίκλειον; Script. Orig. Constant. 1, 93; 2, 168; Hippiatr. 1, 103; Theophan.

sionally they are spelled with a double lambda.¹

As the suffix -ino² indicates, hyalinos means 'of glass.' In most instances where it occurs, it is used of 'a utensil of glass,' 'a glass cup,' or 'a vessel made of glass.' Just as hyalos may stand for some other transparent substance, so hyalinos may mean 'of something which looks like glass.'³ Sometimes it is used in imaginary or suppositional cases, as 'a sea of glass,' 'a glassy humor of the eye.'⁴ The transparency of glass suggests such examples, as it does the comparison of the air with a glass window.⁵ Other characteristics of glass suggested by glass objects are hardness and smoothness.⁶ In a few instances hyalinos is employed with an unusual meaning. Josephus uses it to characterize sand.⁷ In this case it seems to have the meaning 'transparent like

Nonn. 1, 105; Geop. 9, 19, 11; 10, 7, 6; 10, 56, 6; 10, 691; 10, 70; Zonar. Lex. 1043; Anon. on Arist. Rhetor. 170; Etym. Magn. 451, 27; Demetrius, Hieracosophion, 205, 222; Joan. Actuarius, de Urinis, 33, 7; Nemes. de Nat. Hominis, 13 (Patr. Gr. 40, 665 A).

¹Lucian, Ver. Hist. 2, 11 (Ms. N, Niclén); Ps. Callisthenes ed. Meus. 2, 38 (quoted from Crönert, Memor. Gr. Hercul. 75); Zonar. Lex. 1043.

²Brugmann-Thumb, Griech. Gram. ed. 4, 194: "Suffix -ino, -ina - ist b) von unklarem Ursprung in Adjektiven, die Stoff, Herkunft, Art bezeichnen."

³Probably the coffins mentioned in Strabo 17, 1,8; Aelian, Var. Hist. 13, 3, were simply of some substance that resembled glass (see above).

⁴Rev. 4,6: ἐνώπιον τοῦ θρόνου ὡς θάλασσα ὑαλίνη, ὁμοία κρυστάλλῳ. Idem, 15, 2: ὡς θάλασσαν ὑαλίνην περιγυρμένην πυρί... ἐστῶτας ἐπὶ τὴν θάλασσαν τὴν ὑαλίνην. The comparison with crystal here suggests that transparency was the principal idea in the mind of the author of Revelations. Philoponus on Arist. de Anima, 351,32: ἀλλ' εἰ ἡ λήρη ἐπιτιθεμένη διὰ τὸ μὴ εἶναι διαφανὲς ἀντιφράττει τῷ φωτὶ, ἔδει, εὔπερ ἐπινοηθεῖν ὑαλίνην λήρη ἢ ἐξ ἄλλης διαφανοῦς ὕλης, μὴ ἐρποδίζειν ἐπιτιθεμένην ἐν τῷ ὀφθαλμῷ, ὥστε ὁρᾶσθαι αὐτήν.

⁵Athanasius (Patr. Gr. 28, 789 B).

⁶Philoponus on Arist. de Anima, 429: ἐὰν σκληρὰ πάνυ καὶ λεπτά σώματα λάβοις, οἷον ὑάλινα ἢ χαλκὰ στιλβωθέντα ἀκριβῶς.

⁷Joseph. Bell. Jud. 2, 10, 2: τὴν ὑαλίνην ψάμμον (ὑαλίνην, c i. ras. m. 2L ὑαλίνην VRC Niese). Thes. Gr. Ling. 8, 6 and Liddell and Scott

glass' rather than 'fit for the production of glass,' which is properly hyalitis. Similarly Basilus uses hyalinos in connection with a membrane.¹ It is possible that an anonymous writer on Sancta Sophia has employed hyalinos in the same way.²

(j) Hyalios (hyelios). -- The masculine form of the adjective, hyalios, appears only with the absurd definition polemios,³ probably from a false inference or confusion with Enyalios.⁴ The neuter hyalion has the same meaning as hyalinos.⁵ Hyalion is also used as a substantive to stand for glass⁶

cite this passage under υάλικος and give it the meaning "suitable for making glass." I have been unable to find any authentic instance of hyalikos except in a corrupt and as it now stands quite unintelligible passage in Hesychius: υάλικος κώρη· Διονύσιος. υαλκάδαρχος παίδων. Λάκωνες, where there is certainly no reference to 'glass.' The form υαλίκην in Josephus has no Ms. authority whatsoever and is due to a misprint in Havercamp's 1726 ed. of Hudson's text (London 1720) where υαλίνην is correctly printed.

¹Basil. Homil. 6 (Patr. Gr. 21, 1473 D): ἐφαίνετο γάρ, ὡς περ φῶς δι' υελίνων ὑμένων, διὰ τοῦ ἀνθρώπινου σώματος ἡ θεία δύναμις.

²Anon. Διήγησις περὶ τῆς Ἁγίας Σοφίας (Script. Orig. Const. 1, 93 ff.): κατεχρύσωσι ἐξ υελίνου χρυσοῦ λαμπροτάτου. This might mean 'gold, like unto pure glass', but it is more probably the gold colored glass mosaic so common in early churches.

³Photius; Bachmann, Anecd. Gr. 1, 393: υάλιος πολέμιος.

⁴Suid. υάλιος πολέμιος καὶ Ἐνυάλιος. "Mihi videbatur καὶ ἐνυάλιος ab homine docto profectum fuisse, qui monstrum vocis υάλιος animadversum corrigeret," Bernhardt.

⁵I G II 645: υάλιον ἀργυροῦ κοίτηλον, Boeckh. "fortasse emendandum est υάλινον", Koehler. Suid. υέλιον καὶ υελος καὶ υέλινον.

⁶Leo Gram. Chronographia (Script. Hist. Byz. 47, 215), Pieces of glass probably in the form of gems: τὰ δύο μέγιστα ὄργανα δλόχρυσας διαφόροις λίθοις καὶ υελίοις καλλύνας αὐτά. Compare Georgius Monachus (Patr. Gr. 110, 1009). Demetrius, Hieracosophion. 275, one of the components of a plaster is υελίου μέρος ἐν. Codinus Curop. De officiis pal. Constantinop. 4 (Patr. Gr. 157, 40): καὶ τὸ τοῦτο σκαράνικον τὸν βασιλέα εἰκονικῶς, ἔμπροσθεν ῥέν ἱστάμενον ὑπὸ υελίου λεγομένου δια γέλαστος.

as well as objects made of glass, such as cups,¹ mirrors,² and windows.³ It likewise designates the vitreous humors of the body.⁴

(k) Hyalitis (hyelitis).-- Hyalitis is applied to sand with the meaning 'that from which glass is made.'⁵

(1) [Hyalkadai].-- See above note 7, page 47.

¹Const. Porph. De cer. aulae Byz. 2, 44 (Script. Hist. Byz. 9, 661), gifts sent by the emperor to the king of Italy: ποτήριον ὀνυχίτου α'. ὑέλια κλεοπτ. ιζ'. On the ε for α see Psaltes, Gram. der byz. Chron. 4, 6.

²Suid. σπέκλον. τὸ ὑέλιον, τὸ σπέτλον. Compare Damasc. Stud. Homil. 25: ἐκίταξα εἰς τὸ ὑάλιον τὸ πρόσωπόν μου (quoted from Ducange).

³Anon. Διήγησις περὶ τῆς Ἁγίας Σοφίας (Script. Orig. Const. I, 90): δὲ τῶν ὑελίων. Salmasius takes σπέκλον to mean window glass. Plin. Exercit. 770 b, G: "Graeci ὑέλια. Immo ita etiam appellarunt, etiamsi ex speculari lapide essent, non ex vitro. Neophytus monachus in Lexico Herbario: τὸ τοῦ φεγγίτου ὑέλιον, hoc est, vitreum ex speculari lapide. Quod fenestris obducebatur ad translucendum, ac lucem admittendam, speculari veteres Latini vocarunt. . . 771a A. Idque ex speculari lapide qui est φεγγίτης, aut ex vitro fiebat, aut alia translucida materia... Haec specularia porro fenestris indita ad perspicendum Graeci ὑέλια vocarunt, quae ex vitro fierent, Latini vitria... C. Neophytus ὑέλιον etiam vocat specular, quod ex phengite lapide, non ex vitro compositum est... E. Paulus Silentarius de fenestris templi sanctae Sophiae - δοχὴν φωτὸς ἀνοίγει λεπταλέαις ὑέλοις κεκαλυμμένην. Haec sunt proprie quae ὑέλια dicuntur uno verbo Graecis, specularia nempe ex vitro."

⁴Niceph. Blemm. de Lib. Med. (Heisenberg, Nic Blem. Curr. Vit. et Carm. "In codice enim Vindob. Med. Graec. 45 saec. XIV haec opuscula exstant." 87 -- 3. a. fol. 30^v | inc.: τῶν ἁρθευῶν ὑέλια. 3 fol. 35^v | inc. (same as above) Uno codice Vindob. Theol. Graec. 245 saec XV/XVI. fol. 312^r hic titulus praebetur: διαγνώσις ὑελίων τοῦ οὐρου. See Ducange s.v. ὑέλιον.

⁵Theoph. de Lap. 49: ἐκ τῆς ὑελίτιδος. See Lobeck, Paralipom. 52. Strabo, 16, 758: τὴν ὑαλίτιν ἄρμον... ὑαλίτιν ψάρμον... ὑαλίτιν γῆν Eustath. Comm. on Dionys. Periegetes, 912: ψάρμος ὑαλίτις.

(m) Hyaloeis.-- Hyaloeis is defined by Hesychius¹ as transparent and bright. Rufinus² uses this form in describing a beauty whose cheeks are like glass.

(n) [Hyalomai].-- See above note 2, page 40.

(o) Hyalous (hyelous).-- See above page 43.

(p) Hyalôdês (hyelôdês).-- Although hyalinus and hyalous may occasionally denote 'glass-like' the words that usually convey that meaning are hyaloeidês,³ or hyeloeidês,⁴ (hyeloidês),⁵ and hyalôdês,⁶ or hyelôdês.⁷

As early as the fifth century Philolaus describes the sun as "a glass-like (hyaloeidês) body which receives the reflected

¹Hesych. s.v. ὑαλόεις· διαφανές· λαμπρόν. Cf. Theognostus, Canones, 18, 29; Zonar. Lex. 1760; Philemon, Lex. Tech. 248: ὑαλόεις· τὸ διαφανές.

²Rufinus (Anthol. Pal. 5, 48): καὶ ὑαλόεσσα παρειαί.

³Hippocrates (Kuhn, 21, 289); Theoph. de Lapid. 5, 30; Rufus, 154, 165, 171, 597; Aët. 2, 20, 12 (Diels, Doxogr. Gr. 349); Galen, 3, 760; 761, 762, 766, 767, 768, 777, 779, 787, 789, 830; 4, 160, 5, 446, 623, 788; 6, 789; 7, 749; 10, 48; 14, 712; 16, 30; 19, 275; Pollux, 2, 71; Euseb. 15, 23; Orib. 3, 294 (from Galen), 295, 296, 298, 301, 302; Orphica, Lith. 280 (uncontracted), Theodoret, Gr. Affect. Cur. 105; Michael Glycas, Annal. 1, (Script. Hist. Byz. 27, 40, 3).

⁴Aët. 2, 25, 11 (Diels, Doxogr. Gr. 356); Ach. Tatius, Isagoge ad Arati Phaenom. 19; Cassius, Probl. 154; Stobaeus, I, 26, 1; Aëtius Amid. (Hirschberg, Die Augenheilkunde, I); Theophilus, de Corp. Hum. Fabr. 4, 15, 3; 19, 5.

⁵Cass. Probl. 27 (Ideler, Phys. et Med. Gr. 1, 154, 15 ff.).

⁶Hippocrates (Kuhn, 21, 254); Galen, 6, 255, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 367, 585; 17, 1, 429, 848; Palladius, de Febr. Synopsis, 8, 1; 27, 2; Paul. Aeg. 46, 25; Theophilus, de Urinis, 8, 2 (Ideler, 1, 269); Leo Philos. Conspectus Medic. 3, 1; Theophan. Nonn. 170; Psellus, Carmen de Re Medica, 635.

⁷Dioscorides, 3, 86 (96); Galen, 13, 942; Meletius, de Nat. Hominis (Patr. Gr. 64, 1168).

light of the fire in the universe and transmits it to us."¹ Ion of Chios calls the moon hyeloeidê, "transparent like glass."² But the physicians make the greatest use of hyaloeidês and hyalôdês³ to describe the various humors and phlegms of the body⁴ and the vitreous

¹Aët. 2, 28, 12 (Diels, Doxogr. 349 ff.): Φιλόλαος ὁ Πυθαγόρειος ὑαλοειδῆ τὸν ἥλιον, δεχόμενον μὲν τοῦ ἐν τῷ κόσμῳ πυρὸς τὴν ἀνταύγειαν, διαθοῦντα δὲ πρὸς ἡμᾶς τὸ τε φῶς καὶ τὴν ἀλέαν, ὥστε πρόπον τινὰ διττοῦς ἡλίους γίνεσθαι, τὸ ἀπ' αὐτοῦ πυροειδὲς κατὰ τὸ ἐσοπτροειδές.

Galen, 19, 275; Theodoret, Gr. Affect. Cur. 105. Plutarch and Galen omit τὴν ἀλέαν. Ach. Tat. Isagoge ad Arati Phaenom. 19: Φιλόλαος δὲ τὸ πυρῶδες καὶ διαυγὲς λαμβάνοντα ἄνωθεν ἀπὸ τοῦ αἰθερίου πυρὸς πρὸς ἡμᾶς περπεῖν τὴν αὐγὴν διὰ τινῶν ἀραιωμάτων ὥστε κατ' αὐτὸν τρισσὸν εἶναι τὸν ἥλιον, τὸ μὲν ἀπὸ τοῦ αἰθερίου πυρὸς, τὸ δὲ ἀπ' ἐκείνου περπόμενον ἐπὶ τὸν ὑελοειδῆ ὑπ' αὐτοῦ λεγόμενον ἥλιον, τὸ δὲ ἀπὸ τοῦ τοιούτου ἡλίου πρὸς ἡμᾶς περπόμενον.

Eusebius. 15, 23: εἰσκὼν ὑαλοειδῆ. Michael Glycas, Annal. 1 (Script. Hist. Byz. 27, 40): Φιλόλαος δὲ ὑλοειδῆ τοῦτον ἐφιλοσόφει, δεχόμενον... ἡμᾶς. See A. Boeckh, Philolaos des Pythagoreers Lehren, 124 ff.; A. S. Pease on Cicero's de Div. 1, 97.

²Aët. Plac. 2, 25, 11 (Diels, Doxogr. 356): περὶ σελήνης οὐσίας. Ἰων σῶμα τῇ μὲν ὑελοειδὲς διαυγὲς, τῇ δ' ἀφεγγές.

³This form of the word was widely used by the Middle Ages and early modern times, see Castelli, Lex. Med. s.v. Hyalodes.

⁴Hippocrates, 21, 254: καὶ οὔρου πυῶδους καὶ ὑαλώδους (ὑλώδους A). Id. 21, 289: ὠψείλει δὲ καὶ οὔρου διέξοδος ὑαλοειδῆς πολλή, καὶ ῥύσις κοιλίης ῥύσις. Praxagoras in Rufus, 154: Πραξαγόρας δὲ ἴδιον τρόπον τοῦς χυμοὺς ὠνόμαζε, γλυκύν, καὶ ἰσόκρατον καὶ ὑαλοειδῆ.

Id. in Galen, 6, 255: τὸν τοιούτον χυμὸν ὁ Πραξαγόρας ὑαλώδην καλεῖ. Compare Galen, 6, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 585. Id. 16, 367: ὃν ὑαλώδην ἐκάλουν οἱ κατὰ Πραξαγόραν, ὅς ὑαλῶ κεχυμένῳ προσέοικε τὴν χροίαν καὶ τὴν σύστασιν.

Id. 17, 1, 429: τὸ γονοειδὲς δ' οὔρον λέγεται, ὅταν οὐ καλούμενος ὑπὸ Πραξαγόρου χυμὸς ὑαλώδης ἐκκενοῦται.

Id. 17, 1, 848: συμβαίνει δὲ τὰ τοιαῦτα ῥίγη διὰ ψυχρὸν πάνυ φλέγμα τὸ ὑαλώδες ὀνομαζόμενον ἢ τὸν μελαγχολικὸν χυμὸν, κτλ.

Of. Id. 979. On ὑαλοειδῆς see Id. 6, 789. Id. 7, 749: φλεγματοῦ χυμὸς ψυχρὸς, ὃν ὁ Πραξαγόρας ὑαλοειδῆ καλεῖ.

Palladius, de Febr. Synopsis, 8, 1: ἐπὶ τῷ φλέγματι τεσσάραις εἰσι διαφοραί. ἔστι γὰρ τὸ ὑαλώδες, τὸ ὀξύδες, τὸ ἀλυκόν, καὶ τὸ γλυκύ. 8, 2: καὶ τὸ μὲν ὑαλώδες καὶ ὀξύδες ποιεῖ τὰ ἀνεκθέρμαντα ῥίγη.

27, 2: διὰ τὴν τοῦ χυμοῦ γένεσιν. τὸ γὰρ ὑαλώδες καὶ ὀξύδες φλέγμα τὸ ὑποκειμένον ἔστι.

Paul. Aeg. 46, 25: καὶ ποτε καὶ ὑαλώδες ἐπικρίνεσθαι φλέγμα. Theophilus, de Urinis, 8, 2: καὶ ἑτέρας διαφορὰς τοῦ φλέματος, εἰς ἔστι τὸ ὑαλώδες φλέγμα καὶ τὸ ἀλυκόν, καὶ τὸ ἄποιον. Theophan. Nonn. 170: κενωθὲν γὰρ ὑαλώδες φλέγμα, παύονται τῆς ὁδύνης. Psellus, Carmen de Re Medica, 596: τοῦ φλέματος δὲ πολλαπλοῦ πεφυκότος (τὸ μὲν γὰρ ὡς ὑαλὸς αὐτὸς τυγχάνει, | τὸ δ' ἀλυκὸν πέφυκεν, ὀξύδες τρίτον, | τὸ δὲ γλυκεῖας ποιότητός ἐστι πῶς), | ὅπερ πέφυκεν ὡς ὑαλὸς τὴν φύσιν.

humor of the eye, the portion back of the crystalline lens.¹

Id. 635 ff.: ὁ δ' ἡ πλάτος συνθέτως κεκλημένος ἁμφημερινῶ
σύγγονός πως τυγχάνει, ἵεξ ὑαλώδους πνεύματος τεταγμένος.

¹Rufus (ed. Daremberg-Ruelle, 154), on the tunics of the eye: ὁ δὲ
τρίτος περιέχει μὲν ὑαλοειδὲς ὑγρὸν· καλεῖται δὲ ἀρχαῖον ὄνομα
ἀραχνοειδὲς διὰ λεπτότητα... ἄλλοι δὲ καὶ ὑαλοειδῆ ἀπὸ τοῦ ὑγροῦ.
ὁ δὲ τέταρτος περιέχει μὲν τὸ κρυσταλλοειδὲς ὑγρὸν, ἀνώνυμος δὲ
ὢν ἐξ ἀρχῆς φακοειδὲς μὲν διὰ τὸ σχῆμα, κρυστάλλοειδὲς
δὲ διὰ τὸ ὑγρὸν ὠνομασθῆναι.

Id. 171: ὁ δὲ τρίτος ἀπὸ τοῦ αὐτοῦ πόρου προελθὼν περιέχει ὑγρὸν [ὑπο]
τῷ λευκῷ παραπλάσιον καλούμενον ὑαλοειδὲς, κτλ. Cf. Id. 597. For a recon-
struction of the eye according to Rufus of Ephesus see prospectus,
Studies in the History and Method of Science, ed. Charles Singer,
Oxford, 1921. Galen, 3, 760 ff.: καὶ μὲν γε ὡς εἰς ἐκάτερον αὐτῶν
ἐκ φύσεως ἐγκεφάλου καθήκουσι, πιλούμεναι μὲν κατὰ τὴν διὰ τῶν ὁσπῶν
ὁδῶν ἐνεκα δυσπαθείας, ἐπειδὴν δ' εἰς αὐτοὺς ἀφίκωνται τοὺς ὀφθαλμοὺς,
αὐθις λυόμεναι τε καὶ πλατυνόμεναι, καὶ περιλαμβάνουσαι μὲν
ἐν κύκλῳ χιτῶνος σίκην τὸ ὑαλοειδὲς ὑγρὸν, ἐρφυόμεναι δὲ εἰς
τὸ κρυσταλλοειδὲς. καὶ γὰρ καὶ ταῦτ' εἴρηται πρόθεν, καὶ ὡς αὐτὸ
τὸ κρυσταλλοειδὲς ὑγρὸν τὸ πρῶτόν ἐστιν ὄργανον τῆς ὁψews.

Cf. Id. 3, 777, 779, 787, 830; 4, 160; 5, 446. Id. 5, 623: εὐρήσεις
γὰρ ὑπὸ τοῖς χιτῶσιν ἔνδον ὑγρὰ σφαιροειδῆ σιττα, τὸ μὲν οὕτω
βαλακόν, οὗ ἀπὲρ ἐστὶν ὕαλος ἢ μετρίως λυθεῖσα, τὸ δ' οὕτω σκληρόν,
οἷος ὁ μετρίως παγεῖς κρυστάλλος. ὀνομάζεται δ' ὑπὸ τῶν ἰατρῶν
ὑαλοειδὲς μὲν τὸ βαλακώτερον, κρυσταλλοειδὲς δὲ τὸ σκληρότερον, ἀπὸ
τῆς πρὸς ὑαλόν τε καὶ κρυστάλλον ὁμοιότητος, οἷς οὐρόνον ταῖς συστάσεσιν,
ἀλλὰ καὶ ταῖς χροαῖς ἔοικεν· ἀκριβῶς γάρ ἐστι καθαρά, καὶ διαυγής, καὶ λαμπρά, κτλ.

Cf. Id. 5, 788; 10, 48, 760, 762, 766, 767, 768; 15, 712; 16, 30.
Pollux (ed. Bethe), 2, 70: τὰ μέρη δὲ τῶν ὀφθαλμῶν χιτῶνας
ἐκάλεσαν οἱ ἰατροί· τέτταρες δ' εἰσὶ τὸν ἀριθμόν... 71: τῷ
δὲ τρίτῳ, φακοειδεῖ, καὶ κρυσταλλοειδεῖ, καὶ ὑαλοειδεῖ.

Compare Orib. 3, 294 ff. (295): καὶ τοίνυν καὶ γέγονε καὶ παρσκευάσται
πρὸς τῆς φύσεως ἐπιτήδειος αὐτῷ τροφὴ τὸ ὑαλοειδὲς ὑγρὸν, ὅσω
παχύτερον καὶ λευκότερον αἵματος, τοσοῦτω τοῦ κρυσταλλοειδοῦς
ἀπολειπόμενον παχύτητι τε καὶ φανότητι... δηλον ὅτι ὡς κατὰ διάδοσιν
τρέφεται, τὸ μὲν κρυσταλλοειδὲς ἐκ τοῦ ὑαλοειδοῦς, τὸ δὲ ὑαλοειδὲς ἐκ
τοῦ περιέχοντος αὐτὸ σώματος, ὃ πλατυνθείσης τῆς ἄνωθεν κατι-
ούσης ἐγκεφάλου μοίρας ἐγένετο, κτλ. Id. 3, 297: ὥστε διὰ τῶν μέσων
σωμάτων τὸ ὑαλοειδὲς ὑγρὸν τῷ πάντων ἔκωθεν ἤνιωται χιτῶνι,
τὸ βαλακώτατον τῷ σκληροτάτῳ. Id. 3, 301: οὐδὲν δὲ ἥττον αὐτῆς
θαυμάζω καὶ τὴν ἐπιτραφεῖσιν ἐντὸς δασύτητος τῷ περιέχοντι τὸ
ὑαλοειδὲς ὑγρὸν χιτῶνι· νοτερά γὰρ αὕτη καὶ μαλθακὴ καθάπερ σπογγία, τοῦ
κρυσταλλοειδοῦς ὑγροῦ ψανουσα, τὴν τοῦ χιτῶνος ὅλου γειννίασιν ἀλυπον αὐτῷ παρέχει

Cass. Iatr. Probl. 27 (Ideler, 1, 154): τοῦτο κατάδηλον, ὅτι ὀφθαλμὸς
ὑγρὰ περιέχει· τὸ τε ὑδατώδες, ἀφ' οὗ τὸ δάκρυον, καὶ τὸ
κρυσταλλοειδὲς καὶ τὸ υαλοειδὲς. Theod. Prisc. 4, 2, extr.:
humorem vitreum, quem Graeci hialoiden vocent. Georges, Ausführ-
liches latein.-deutsch. Handwörterb. ed. 8, 1, 2, and Harper's Lex.
incorrectly translate as 'glassgreen.' Aët. Amid. (Hirschberg,

Besides the sun, the moon and humors, a few other things, such as gems,¹ gum,² and asphalt,³ are called 'glasslike.' Objects or substances so designated would seem to be either transparent, occasionally with the additional idea of the consistency of glass in the liquified state, or glistening, or else hard and brittle, as the context requires.

(q) Hyalôma.-- Hyalôma⁴ is a disease of the eye, glaucoma, in which the vitreous humor becomes opaque.

(r) hyalôps.-- See below page 54.

Die Augenheilkunde I): ὕγρα δὲ ἔστιν ἐν τῷ ὀφθαλμῷ τρία· ἐνδοθεν μὲν πάντων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀμφιβληστροειδοῦς χιτῶνα υἰλοειδὲς λεγόμενον, κτλ. Theophilus, de Corp. Hum. Fabr. 4, 15, 3 (ed. Greenhill, 152): ἐν γὰρ τῷ ὀφθαλμῷ τριῶν ὑγρῶν ὄντων, τοῦ κρυσταλλοειδοῦς, τοῦ υἰλοειδοῦς, καὶ τοῦ ὠροειδοῦς, πρῶτον ὄργανον ὁρατικὸν τὸ κρυσταλλοειδὲς ἐγένετο, τὰ δὲ ἄλλα τροφῆς ἐνεκεν. 4, 19, 5 (159): ἡ δὲ λεπτή μὲν γὰρ σὺν τῷ νεύρῳ πλατυνομένη γεννᾷ τὸν ἀμφιβληστροειδῆ χιτῶνα. ἐπεκτείνόμενος δὲ ὁ ἀμφιβληστροειδὴς χιτῶν περιέχων καὶ τὸ υἰλοειδὲς ὑγρὸν συμπαραλαμβάνει τὸν ὠροειδῆ χιτῶνα, περιέχοντα τὸ κρυσταλλοειδὲς ὑγρὸν, καὶ μέρος τι τοῦ υἰλοειδοῦς εἰς τροφὴν τοῦ κρυσταλλοειδοῦς.

Meletius, de Nat. Hominis (Patr. Gr. 64, 1168): εἰσὶ δὲ τὰ τοῦ ὀφθαλμοῦ ὑγρά τὸν ἀριθμὸν τρία. καὶ πρῶτον μὲν ἔστι τὸ υἰλώδες· ὃ καὶ κατὰ τὸ μέσον ἔγκειται τοῦ ὀπτικοῦ πόρου· ὅθεν αἱ διεσπαρμέναι ἴνες παιοῦσι τὸν ἀμφιβληστροειδῆ. καλοῦσι δὲ υἰλώδες τοῦτο τὸ ὑγρὸν, ὅτι περ παραπλήσιόν ἐστιν ὑέλῳ, κατὰ τε τὸ χρῶμα καὶ κατὰ τὴν σύστασιν.

Leo Philos. Conspect. Medic. 3, 1: εἰσὶ τρία ὑγρά· τὸ υἰλώδες λεγόμενον, ἑπεὶ δὲ ἔοικεν ὑέλῳ.

¹Theophrastus, de Lapid. 30: ἔξ ὧν δὲ τὰ σφραγίσδια ποιεῖται καὶ ἄλλαι πλείους εἰσὶν, ὅσον ἢ θ' υἰλοειδῆς ἢ καὶ ἔρψασιν ποιεῖ καὶ διάφασιν, καὶ τὸ ἀνθράκιον, καὶ ἡ ὕμφαξ. Orphica, Lith. 280: ἐσθλοὶ δ' αὖτ' ἐπὶ τοῖσι καὶ υἰλοειδέες εἶναι κλείονται θνητοῖσι θνητολέουσι τόπαροι.

²Dioscorides, 3, 86 (96): de Euphorbio: ἔστι δὲ δύο γένη τοῦ ὀποῦ, τὸ μὲν διαυγές, ὡς σαρκοκόλλα, κατὰ μέγεθος ὀρόβου, τὸ δὲ τι ἐν ταῖς κοιλίαις υἰλώδες καὶ συνεστῶς.

³Damocrates in Galen, 13, 942: πυκνῆς τε υἰλώδους πρόσβαλ' ἀσφάλτου β'. Probably brittle and glistening like obsidian (a natural glass).

⁴Apsyrus in Hippiatr. 1, 11: Ἀψύρτου περὶ ὀφθαλμῶν λευκώματος. γλαυκώματος δὲ γεγονότος, περιέργον καὶ τὸ φλεβοτομεῖν. ἔστι γὰρ ἀθεράπευτον. συμβαίνει δὲ ἐκ τούτου ὁ καλεῖται ὑάλωμα, ὅμοιον ψηφίδι λευκῇ.

5. Compound Derivatives: (a) [Hyelakykades].-- In Crinagoras,¹ where he is describing pears offered to Pan, hyelakykades occurs. Many emendations have been offered for this form,² nearly all of which agree that there is something glass-like about the pears. Some kinds of ripe pears do, of course, look shiny and semi-transparent.

(b) Hyelepsês.-- The glass-smelter is designated by a special word,³ which varies in form and spelling, hyelepsês,⁴ hyelepsos,⁵ hyalopsos,⁶ (hyelopsos),⁷ hyalôps,⁸ and hyeloepsos.⁹

(c) Hyelepsos.-- See above.

¹Anth. Pal. 6, 232: ὕελα κυκάδες ὄγχναι.

²See Stadtmueller, Anth. Gr. 1, 350 ff.: "ὅς ὕελα κυκάδες (hyphen, accentum AC) P | ὕελο κυκάδες ap. L. ὕελο κυκκάδες Heck. (αἱ μελιπιδάδες Geist ὕαλοχρώδες Br. ὕετο κυκάδες Reiske ὕελοοῖδάδες Tour ὕελο-μυράδες Picc. εὐ μάλ᾽α κυκλάδες Jac. ὕελοχυλάδες Emper)."

³Friedrich (Rhein. Jahrb. 74, 172; Blümner: Tech. u. Term. 4, 384.

⁴Hesych. ὕελέψης. ὕελο... "ὕελο τέχνη" Mus., qui compendium superscriptum delevit." Olympiod. on Arist. Meteor. 2, 228: παρὰ τοῖς ὕελέψαις. The Aldine edition has a double lambda.

⁵Michael Glycas, Annal. 4, 506, 7: ὁ ὕελεψός. Psaltes, Gram. der Byz. Chron. 4, 6. Compare Leontius Cyprius (Patr. Gr. 93, 1736 D); Act. Sanct. Iuli. T. I, 168, 16; 164, 52 (quoted in Thes. under ὕελέψης). Blümner, Tech. u. Term. 4, 389, n. 2, quotes Act. Sanct. Iuli. T. I, 164, as τοῦ ὕελεψοῦ, a passage which I have been unable to verify.

⁶Joan. Moschus, Prat. Spirit. (Patr. Gr. 87, 2932 A): ὕελοψός. Schol. on Luc. Lexiph. 7.

⁷Cedremus (Script. Hist. Byz. 34, 687, 1): ὕελοψός. With double lambda, Herod. Epim. 138: ὕελλοψός.

⁸Pallad. Schol. on Hippocrates, 2, 222: ὁ ὕαλωψ. See Lobeck, Paralipom. 291.

⁹Niceph. Blemmy-des, de Fabr. Auri Cod. Reg. 2329, 159^v: εἰς κάρινον ὕελοεψοῦ, Hase (quoted from Thes. Gr. Ling. 8, 6).

(d) [Hyelinopoios].-- For some time Yilinopoios, a word found in an inscription of Sparta of the first century before Christ, was thought to stand for hyelinopoios, 'one who makes things of glass,'¹ but the correction of this to psilinopoios, 'maker of palm garlands' has been universally accepted.²

(e) Hyaloeides (hyeloeides).-- See above page 50.

(f) Hyeloepsos.-- See above page 54.

(g) [Hyalokeras].-- An error, see above note 5, page 34.

(h) Hyalotechnes.-- See above note 4, page 54.

(i) Hyalourgeion.-- See below page 56.

(j) [Hyalourgia].-- See below note 1, page 50.

(k) Hyelourgikos.-- See below page 56.

(l) Hyalourgos (hyelourgos).-- Strabo is the first to mention the hyalourgos vitrearius,³ 'glass-maker.'⁴ The same form occurs in a list of traders and artificers in the Tebtunis Papyri,⁵ and spelled with an epsilon, in extracts from Julian of Ascalon.⁶

¹F. Welcher (Bull. Inst. 1844, 147): Νικοκλῆς ἐκ τῶν σάρους ὑελινοποιός.

²Conge-Michaelis (Annal. dell' Inst. 1861, 39): ψιλνοποιός. I G V¹, 209.

³Corp. Gloss. Lat. vitrearius, ὑαλουργός.

⁴Strabo, 16, 758: παρὰ τῶν ὑαλουργῶν. See Salmas. Plin. Exercit. 769 a E.

⁵p. Teb. 2, 270: ὑαλουργός.

⁶Const. Harmenopulus, Manuale legum, 2, 4, 19: περὶ ὑαλουργῶν... ὑελουργούς. Jules Nicole, Le livre du préfet, 71, Gen. Ms.: περὶ ὑελλουργῶν... ὑελλουργούς.

Corresponding forms are hyalourgeion, 'the place where glass is made',¹ and hyalourgikos, 'of or for making glass.'²

(m) Hyalochroos.-- Leonidas³ mentions a glass-colored band. It is very difficult for us with our colorless glass to understand what hyalochroos, 'glass-colored' means, but most ancient glass, unless artificially colored, has a greenish cast. Among the Romans vitreus seems to have been used occasionally to express glass-green,⁴ probably in imitation of the Greek, although no instances of such a use occur in Greek literature. A passage has already been noted where Dioscorides describes resin as 'like glass in color' probably to express its transparency.⁵ It may not be impossible to consider 'glass-colored' when applied to a garment, as a reference to the sheerness of the material, but it seems more

¹Diosc. 5, 181: ἐκ τῶν ὑαλουργείων. "ὑαλουργός, δ. vitriarius, qui vitra conficit. Bud. ex Dioscor. I 5, 181, ubi hodie ex correct. Sarac. et J. G. Schneideri legitur ἐκ τῶν ὑαλουργείων, quod v. Hase]" (quoted from Thes. Gr. Ling. 8, 9. Paul. Aeg. 106V, 10: ἐκ τῶν ὑαλουργείων. Hase in Thes. suggests that this should be written ὑαλουργείων, which seems probable since ὑαλουργία could hardly mean a workshop where glass was manufactured, which seems to be the meaning required here, or in Dioscorides from whom this passage is quoted.

²David. Proleg. et in Porphyr. Isogogen, 20, 11 ff.: ὑαλουργική ἐστὶ τέχνη. Compare Nicephorus Blemmida, Epit. log. (Patr. Gr. 142, 697). Geop. 20, 16: εἰς κάμινον ὑαλουργικῆν.

³Anth. Pal. 6, 211, among the things dedicated by Calliclea to Cyprus: καὶ ὑαλοῦχον ὑαλόχροα. Various meanings have been suggested. Dübner translates "vitricolore," but in the notes gives, "Caerulei, subviridis," quoting Brunck who rejects the suggestion of Larcher that the word meant 'transparent.'

⁴Blümner, Farbenbezeichnungen bei den rom. Dichtern, 218.

⁵See above page 44.

probable that a light green hue is meant.

(n) Hyalopsos (hyelopsos).-- See above page 54.

(o) Hyelôpizô.-- See below under hyelope.

(p) Hyalôpis.-- The transparency of the jasper is expressed by hyalôpis.¹

(q) Hyelôpê.-- Hyelôpê is a disease of the eye among hawks, and the corresponding verb, describing the condition of the eye in this disease, is hyelôpizein.²

(r) Hylaitchos.-- Fick³ would derive Hylaitchos, a river in west Locris, from hyalos and aitho. The appearance of water would be well described by such a name as 'glass-shining,' but the etymology is more than dubious, as the first element is not Hyal- but Hyl-.

(s) Hypohyelion.-- The form hypohyelion⁴ seems to mean 'covered over with glass' or 'something that looks like glass.'

¹Orph. Lith. 613: ἐν γὰρ οἱ δῆεις ὁρώων δάλωπιν ἰάσπιν σάρδιά θ' αἵματόεντα καὶ αἰγλοήεντα μάραγρον.

²Demetrius: Ὀρεοσοφίον ἀγροικότερο, 122: εἰς δελωπὴν ὀφθαλμοῦ. εἰάν δ' ἔραξ δελωπίσῃ τοὺς ὀφθαλμούς, οὕτως αὐτὸν νοήσεις... ἥλον κυπαρίσσινον λεπτὸν ποιήσας καὶ πυρώσας εἰς τὴν αὐτοῦ ῥίνα ἔμβαλε αὐτὸν ἐκ τρίτου, δ' ταυτὴν δελωπὴν ἔδης.

³A. Fick (Bezz. Beitrage, XXII, 63).

⁴Codinus Curop. de Officiis Pal. Constantinop. 4 (Patr. Gr. 157, 40, 4): τὸ δικανίκιον τοῦ πρωτοβεστιαρίου χρυσοπράσινον, χρυσοχοϊκόν, ὑποῦελιον. "Cod. alter-ὕ ὑπὸ ελίου" according to DuCange on δέλιος, vitreus.

D. Krystallos

Since hyalos, as I have already shown, is occasionally used for krystallos, one might naturally expect to find the reverse, either because glass was actually mistaken for crystal, or because krystallos was employed as a figurative equivalent for hyalos.¹

The resemblance of rock-crystal to ice, the original meaning of krystallos,² led to its being designated by the same word.³ In spite of the great similarity in the appearance of glass, it does not seem to have been called crystal in the early literature, at

¹In Latin poetry crystallum, in Blümner's opinion (Tech. u. Term. 4, 386), appears not infrequently for vitrum, but the Thesaurus L. L. does not seem to recognize that meaning, at least explicitly. In view of the extreme scarcity of actual rock-crystal among ancient remains, as compared with glass, it appears almost certain that crystallum must frequently mean nothing more than glass, but it is difficult to prove this for any particular passage. Thus, for example, it probably would be impossible to show from the great majority of references to it in literature, that in English a 'watch crystal' is not actually made of 'crystal,' but regularly of glass.

This topic will be taken up later in a discussion similar to the foregoing on the Latin words for glass.

²Il. 22, 152 (151): ἡ δ' ἑτέρα θέρει προέει εἰκυῖα χαλάσῃ ἢ χιόνι ψυχρῇ ἢ ἐξ ὕδατος κρυστάλλῳ.

Od. 14, 477 (475): νύξ δ' ἄρ' ἐπ' ἦλθε κακὴ Βορέας πεσόντος, ἰππηγυλὶς· αὐτὰρ ὕπερθε χιῶν γένετ' ἡύτε πάχνη, ἰψυχρῇ, καὶ σακέεσσι περιτρέφετο κρυστάλλῳ.
Hdt. 4, 28: ἡ δὲ θάλασσα πύγνυται καὶ ὁ Βόσπορος πᾶς δὲ Κιρκέριος, καὶ ἐπὶ τοῦ κρυστάλλου οἱ ἐντὸς τέφρου Σκύθαι κατοικημένοι στρατεύονται καὶ τὰς ἀράξας ἐπελαύνουσι πέρην ἐς τοὺς Σίνδους.
Leo Meyer, Handb. d. gr. Etym. 2, 415; E. Boisacq, Dict. Etym. de la Lang. Grec. 522.

³Strabo, 15, 67, of India: φέρει δὲ καὶ λίθιναν ἢ χώρα πολυτελῆ κρυστάλλων καὶ ἀνθρώπων παντοίων, καθάπερ τῶν μαργαριτῶν.

Ael. N. A. 15, 8: ὁ δὲ ἐν Ἰνδίᾳ χειρσατος οὐ λέγεται φύσιν ἔχειν ἰδίαν, ἀλλὰ ἀπογέννημα εἶναι κρυστάλλου, οὐ τοῦ ἐκ τῶν παγετῶν συσταμένου, ἀλλὰ τοῦ ὀρυκτοῦ.

least, but the two are constantly associated.¹ The adjectival forms krystalloeides and hyaloeides also frequently occur in close relationship. Some of the early philosophers described the heavens and the heavenly bodies as 'like crystal'² while others preferred to speak of them as 'like glass.'³ The physicians designated part of the eye as the crystalline lense, from the character of its humor, and the part next to it as the vitreous humor for a similar reason.⁴

Although Hesychius⁵ says that krystallos is a 'kind of glass,' if the Greeks occasionally called glass 'crystal' (as the Romans seem to have done, see above n.1, p.58) it is difficult in any particular passage to be certain of it. In the following instances only does it seem probable that glass was the actual substance which is called crystal. Diodorus⁶ composed an epigram

¹p. Holm. 1. 5: κρυστάλλου μάλαξις τραγείῳ αἵματι βέσας μάλασσεν. τὸ δὲ αὐτὸ καὶ δέλω. Andreas Caes. on Revelations, 21, 21 (Patr. Gr. 106): καὶ ἡ πλατεῖα τῆς πόλεως, χρυσεόν καθαρὸν ὡς ὕαλος διαυγές... διὸ τὴν πλατεῖαν τῆς πόλεως, διὰ μὲν τὸ πολυτελές καὶ εὐχρουν, ὡς χρυσεόν, διὰ δὲ τὸ καθαρὸν, ὡς κρυστάλλου ἐθεάτατο, [ἔστι ὡς ὕαλον διαυγῆ] ἅπερ ἁρμότερα ἐν ἐνὶ συνδραμεῖν παρ' ἡμῖν, ἀδύνατον.

²Aët. 2, 14, 3 (Diels, Doxogr. Gr. 344): Ἀναξίμενης ἕλων δίκην καταπεπηγέναι τὰ ἄστρα τῷ κρυσταλλοειδεῖ. Id. 2, 11, 2 (Doxogr. Gr. 339): Ἐμπεδοκλῆς στερεμνιον εἶναι τὸν οὐρανὸν ἐξ ἀέρος συμπανέντος ὑπὸ πυρὸς κρυσταλλοειδῶς, τὸ πυρῶδες καὶ τὸ ἀερῶδες ἐν ἐκατέρῳ τῶν ἡμισφαίριων περιέχοντα.

Lactant de Opif. Dei, 17, 6: an si mihi quispiam dixerit aeneum esse caelum aut vitreum aut, ut Empedocles ait, aerem glaciatum, statimne assentiar? Aët: 2, 20, 13 (Doxogr. Gr. 350): Ἐμπεδοκλῆς δύο ἡλίου... τὸν δὲ φαινόμενον, ἀνταύγειαν, ἐν τῷ ἐτέρῳ ἡμισφαίριῳ τῷ τοῦ ἀέρος τοῦ θερμομιγροῦς πεπληρωμένῳ, ἀπὸ κυκλοτεροῦς τῆς γῆς κατ' ἀνάκλασιν γιγνομένην εἰς τὸν ἥλιον κρυσταλλοειδῆ.

Cf. Diog. Laert. 8, 77.

³See above page 50 ff.

⁴See above n. 1, page 52.

⁵Hesych. κρυστάλλος · εἶδος δέλ[α]λου. On the spelling see Thes. 4, 2018 B.

⁶Anth. Pal. 9, 776: εἰς κρύσταλλον γεγλυμμένην. Ζεύξιδος ἡ χρυσή τε

upon a piece of carved crystal. Now in Greece real crystal seems to have been comparatively rare, but by the first century after Christ glass was common. Actual painting upon carved crystal or glass is no doubt possible, but it is difficult and one might be disposed to think that it would have been hardly satisfactory for a small piece such as this was. I am therefore inclined to think that chroîê, the exquisite tinting which reminded the poet of Zeuxis, refers to the beauty of the color of the carved glass, for carved glass was well known and relatively common, while I know of no instance of carved and tinted crystal.

Leonidas of Alexandria¹ mentions crystal, silver, and topazes as rich birthday gifts for Agrippina. Here nothing would suggest that crystal stands for glass except the fact that the author lived in the great center of glass manufacturing in antiquity. Pausanius² says that 'glass, crystal, and morria and everything else made of stone' are broken by the water of the Styx. He is probably thinking of krystallos as an artificial product, probably a colorless, transparent glass³ such as the variety which Strabo⁴ calls krystallophanê.⁵ In an epigram upon crystal containing water,

καὶ ἡ χάρις· ἐν δὲ τῇ κρυστάλλῳ τὸ καλὸν δαίδαλον Ἀρσινόῃ |
γράφας ταῦτ' ἔπορεν Σατυρῆϊος. εἰρή δ' ἀνάσσης | εἰκῶν, καὶ μεγάλης
λείπομαι οὐδ' ὀλίγον.

¹Anth. Pal. 6, 329: ἄλλος μὲν κρύσταλλον, ὃ δ' ἄργυρον, οἱ δὲ
τοπάξους | πέρψουσιν, πλούτου δῶρα γενεθλίδια.

²Paus. 8, 18, 5: ὕαλος μὲν γε καὶ κρύσταλλος καὶ μόρρια καὶ ὅσα
ἐστὶν ἀνθρώποις ἄλλα λίθου ποιούμενα καὶ τῶν σκευῶν τὰ κεραμεῖα,
τὰ μὲν ὑπὸ τῆς Στυγὸς τοῦ ὕδατος ῥήγνυται.

³Kisa, Das Glas, 2, 544.

⁴Strabo, 16, 758: καὶ ἐν Ῥώμῃ δὲ πολλὰ παρευρίσκεισθαί φησι καὶ πρὸς
τὰς χροῖας καὶ πρὸς τὴν ῥαστώνην τῆς κατασκευῆς, καθάπερ ἐπὶ τῶν
κρυσταλλοφανῶν.

⁵Liddell and Scott define τὰ κρυσταλλοφανῆ as 'glass-ware,' but
of course Strabo merely means that one variety of glass,
τὰ κρυσταλλοφανῆ, was highly transparent, 'clear as crystal.'

Claudian¹ says that it was fashioned by man. It is difficult to understand how a sphere of crystal could be formed so that it could contain water, whereas glass could easily be blown into such a shape.

¹Anth. Pal. 9, 753: εἰς κρύσταλλον ἔνδον ὕδωρ ἔχουσιν. χιονέη
κρύσταλλος ὑπ' ἀνέρος ἀσκηθεῖσα | δεῖξεν ἀκηρασίοιο παναίολον
εἰκόνα κόσμου, οὐρανὸν ἀγκὰς ἔχοντα βαρύκτινον ἔνδοθι πόρτον.

E. Morria

A certain variety of glass seems to have been called morria. Since there are but two references to it in Greek literature, little can be learned of its nature from that source. In both instances, however, it seems to be an artificial product. In the Periplus of the Red Sea it is mentioned with lithia hyalê as manufactured at Diospolis for foreign trade.¹ Pausanias classes it with glass and crystal and everything else made of stone.² In Latin there is a more frequent use of murra, especially in connection with the vasa murrina,³ but only two authors give any suggestion of its nature. Propertius speaks of "murrine goblets cooked in Parthian ovens."⁴ Pliny, however, describes it as a natural product⁵ first introduced into Rome by Pompey the Great.⁶ He also

¹Perpl. Maris/ Erythr. 6: καὶ λιθίως ὑαλῆς πλείονα γένη καὶ ἄλλης μουρρίνης, τῆς γινομένης ἐν Διοσπόλει. Salmas. Plin. Exercit. 769 a G: τῆς ὑαλῆς μουρρίνης.

²Paus. 8, 18, 5: πέτρα.

³Mart. 9, 39; 10, 80; 13, 110; 14, 113; Juv. 2, Satura 6, 155 ff.; Seu. de Benef. 7, 9, 3; Theonas (Patr. Gr. 10, 1572 D).

⁴Prop. 4, 5, 26: murreaque in Parthis pocula cocta focis.

⁵Pliny, N.H. 33, 5: murrina ex eadem tellure et crystallina effodimus, quibus pretium faceret ipsa fragilitas. Id. 37, 21 ff.: oriens myrrhina mittit inveniuntur ibi pluribus locis nec insignibus, maxime Parthici regni, praecipua tamen in Carmania umorem sub terra putant calore densari. amplitudine numquam parvos excedunt abacos, crassitudine raro quanta dicta sunt potoria. splendor est iis sine viribus nitorque verius quam splendor. sed in pretio varietas colorum subinde circumagentibus se maculis in purpuram candoremque et tertium ex utroque, ignescente veluti per transitum coloris purpura aut rubescente lacteo. sunt qui maxime in iis laudent extremitates et quosdam colorum percussus, quales in caelesti arcu spectantur. iam aliis maculae pingues placent tralucere quicquam aut pallere vitium est -- itemque sales verrucaequae non eminentes, sed, ut in corpore etiam, plerumque sessiles. aliqua et in odore commendatio est.

⁶Id. 37, 18 ff.: eadem victoria primum in urbem myrrhina invexit, primusque Pompeius capides et pocula ex eo triumpho Capitolino Iovi

refers to an imitation in glass.¹ Some scholars have conjectured that murra was a porcelain, others have tried to identify it with a precious or semi-precious stone, such as onyx or sardonyx, which could easily be imitated.² As Kisa has shown, the only murra which has been preserved, at least, is an artificial glass product, namely the Millefiori or glass-mosaic.³

dicavit. quae protinus ad hominum transiere, abacis etiam escariisque vasis expetitis; et crescit in dies eius luxuria. myrrhino LXX H S empto, capaci plane ad sextarios tres calice, potavit ... anus consularis, ob amorem adroso margine eius, ut tamen iniuria illa pretium augeret; neque est hodie myrrhini alterius praestantior indicatura, idem in reliquis generis eius quantum voraverit, licet aestimare ex multitudine, quae tanta fuit, ut auferente liberis eius Nerone exposita occuparent theatrum peculiare trans Tiberim in hortis, quod a populo impericane se dum Pompeiano proludit, etiam Neroni satis erat. vidi tunc adnumerari unius scyphi fracti membra. quae in dolorem, credo, saeculi invidiamque Fortunae tamquam Alexandri Magni corpus in conditorio servari, ut ostentarentur, placebat. T. Petronius consularis moriturus invidia Neronis, ut mensam eius exheredaret, trullam myrrhinam H S CCC emptam fregit; sed Nero, ut par erat principem, vicit omnes H S [X] capidem unam parando. Memoranda res tanti imperatorem patremque patriae bibisse!

¹Id. 36, 198.: fit et album et murrina aut hyacinthos sappirosque imitatum.

²For literature on the subject and a discussion of the different views, see Marquardt, Rom. Privatalt. 744 ff.; Becker-Göll, Gallus, 2, 385 ff.; Kisa, Das Glas im Altert. 2, 546 ff.

³Kisa, Das Glas im Altert. 2, 532 ff. Cf. Morin-Jean (Daremborg-Saglio, 5, 941).

III. THE MANUFACTURE OF GLASS

A. Traditional Origin

By far the earliest glass known comes from Egypt, where it had been manufactured for so many centuries that probably no record of its discovery remained when the Greeks began to interest themselves in the substance. At a relatively early time, however, the Phoenicians devoted themselves to the manufacture of glass, and that with such success that the one tradition which has come down from antiquity regarding its discovery ascribes it to navigators along the Phoenician coast. The account as given by Pliny¹ runs: "According to tradition a ship of natron merchants came to shore and when the men were scattered all along the beach preparing the meal, since there were no stones to support their kettles, they put pieces of natron from the ship under them. When these had caught on fire and the sand of the shore mixed with them, there flowed transparent streams of a new substance, and this was the origin of glass." Some attempt has been made to rationalize the

¹Pliny, N.H. 36, 191: (190, pars Syriae, quae Phoenice vocatur. . .) fama est adpulsa nave mercatorum nitri, cum sparsi per litus epulas pararent nec esset cortinis attollendis lapidum occasio, glaebas nitri e nave subdidisse, quibus accensis, permixta harena litoris, tralucentes novi liquoris fluxisse rivos, et hanc fuisse originem vitri.

story,¹ but scientists seem to be agreed that it is technically impossible.²

¹Froehner, La Verrerie, 2 ff.: "Pour moi, l'erreur de Plin est tout entiere dans sa dernière phrase: 'telle fut l'origine du verre'; s'il avait dit: 'telle fut l'origine de la fabrication du verre au moyen du sel de nitre,' on n'aurait plus aucune objection a hasarder. Les peuples qui ont connu le verre avant les Phéniciens, n'employaient, comme fondant, que la potasse, c'est-à dire un alcali végétal, obtenu au moyen de la combustion de certaines plantes. La Phénicie eut le mérite de remplacer ces sodes imparfaites par l'alcali minéral, le fondant par excellence et sans lequel il est impossible de fabriquer des verres transparents." The latter part of this statement is very properly, it would seem, objected to by Friedrich (Rhein. Jahrb. 74, 168).

²Blümner, Tech. u. Term. 4, 380, 1; Morin-Jean (Darembert-Saglio 5, 936).

B. Materials

The chief materials mentioned in the composition of ancient glass are silicates and alkalis. Sand, the silicate usually employed, was also regarded as the principal ingredient.¹ Its use was known to the Greeks before the process of manufacture became very familiar, for Theophrastus writes, "and if glass too is made from vitreous earth, as some say, this also takes place by compression."² The nature of the sand determined the manufacturing centers and the kind of glass produced. The most noted source of supply was the sand of the Belus river³ (modern Nahr

¹Plin. N. H. 36, 200: accipit harenas, ex quibus aliubi vitrum . . fundit. Galen, 12, 185: κατὰ δὲ τὸν αὐτὸν τρόπον ἢ (γῆ) τὴν θαλὸν ἔχουσα ψάρμιος ἐστίν, ἐν ψάρμῳ γὰρ μάλιστα τῆς τοιαύτης οὐσίας εὐρίσκεται ψήγματα πολλάκις μικρά, καὶ ὅσοι τούτων ἔμπειροι θεασάμενοι τὰς τοιαύτας ψάρμους γνωρίζουσιν ὅποσον ἐξ αὐτῶν ἀθροῖσαι δύνανται τῆς θαλῶν. . . ἀλλ' οὐκ ἐξ ἀπάσης ψάρμου τὸν χρυσὸν ἐξείρουν καὶ τὴν ὕκλον οἱ περὶ ταύτ' ἔχοντες. . . διὰ τοῦτο μὲν οὖν καὶ τοὶ γε πολλοὶ ψάρμοις χρυσοῦ καὶ θαλῶν ψημάτων περιεχομένων οὐκ ἐπὶ πάσας οἱ περὶ ταῦτα δεινοὶ παραγίνονται.
Euseb. (Patr. Gr. 24, 1142 A): vidit enim cogitatus in sabulo vitrum. Intuere ergo quantum distat cogitatus a corpore. Quid videt oculus? sabulum: quid videt sensus? vitrum. Intueris alium et alium: ille enim videt sabulum iste autem videt vitrum, quod necdum est. C. ex sabulo fructum vitri. Theodoret. (Patr. Gr. 83, 617 A): Aen. Gaz. 552: καὶ ἡ ψάρμος διεσκέδασται καὶ τὸ λίτρον διακέχυται ἀλλ' ἀνθρωπεῖα τέχνη καὶνὴν τινα καὶ διαφανῆ τὴν ὕκλον ἐκ τούτων ἐπενόησε.
Excerpta ex commentar. Alexandri et Olympiodori on lib. 4 (Ideler, 29): τὴν κεῖσθαι δὲ φασὶ καὶ πυλὸν καὶ γῆν θαλὸν, τῇν ἔχουσαν ἐν αὐτῇ ὑγρότης, ὅποτ' ἐστίν, ἐξ ἧς ὕελος γίγνεται.

²Theophr. de Lapid. 49: εἰ δὲ καὶ δ ὕελος ἐκ τῆς δελιτίδος ὡς τινὲς φασί, καὶ αὕτη πυκνῶσει γίγνεται.

³Plin. N. H. 5, 75: iuxta Getta, Geba rivus Pacida sive Belus, vitri fertiles harenas parvo litore miscens. Id. 36, 90 ff.: pars Syriae, quae Phoenice vocatur, finitima Iudaeae intra montis Carmeli radices paludem habet, quae vocatur Candebia, ex ea creditur nasci Belus amnis quinque milium passuum spatio in mare perfluens iuxta Ptolemaidem coloniam. lentus hic cursu, insaluber potu, sed caerimoniis sacer, limosus, vado profundus, non nisi refuso mari

Na'mên)¹ in southern Phoenicia. Pliny says "the part of Syria, which is called Phoenicia, bordering upon Judaea, has within the spurs of Mt. Carmel a swamp, which is called Candebia. It is thought that the Belus river rises from this and after a distance of five miles flows into the sea near the colony of Ptolemais (Ake) . . . The length of the shore is not more than half a mile and this was sufficient for making glass during many centuries." Besides this sand, according to Strabo, "there are those who say that the Sidonians also have vitreous sand suitable for melting."² The glass workers of Alexandria considered their costly, colored glass dependent upon the sands of Egypt.³ Pliny mentions the white sand of the Volturnus between Cumae and Liternum as suitable for making glass.⁴ Gaul and Spain also seem to have had their sources of

harenas fatetur; fluctibus enim volutatae nitescent detritis sordibus. tunc et marino creduntur adstringi morsu, non prius utiles. quingentorum est passuum non amplius litoris spatium, idque tantum multa per saecula gignendo fuit vitro (compare Isid. Etym. 16, 16, 1). Tac. Hist. 5, 7: et Belius amnis Iudaico mari inlabitur circa cuius os lectae harenae admixto nitro in vitrum excoquantur. Joseph. Bell. Ind. 2, 10, 2: κυκλωτέρῃς μὲν γὰρ ἐστὶν καὶ κοῦλος, ἀναδίδωσιν δὲ τὴν δελίνην ψάρμιον, ἣν ὅταν ἐκκενώσῃ πολλὰ πλοῖα προσχόντα, πάλιν ἀντιπληροῦται τὸ χωρίον, κατασυρόντων μὲν ὥσπερ ἐπίτηδες τότε τῶν ἀνέρων εἰς αὐτὸ τὴν ἕξωθεν ἀργὴν ψάρμιον, τοῦ δὲ μετάλλου πᾶσαν εὐθέως μεταβάλλοντος εἰς ὕελον. θαυμασιώτερον δὲ τούτου μοι δοκεῖ τὸ τὴν ὑπερχυθεῖσαν ὕελον ἐκ τοῦ τόπου πάλιν ψάρμιον γίνεσθαι εἰκαίαν.

¹ Benzinger, P. W., s.v. Belos.

² Strab. 16, 758: μεταξὺ δὲ τῆς Ἀκῆς καὶ τύρου θινώδης αἰγικλός ἐστὶν ὁ ψερὼν τὴν ὕαλτιν ἄρμιον. ἐνταῦθα μὲν οὖν φασὶ μὴ χεῖσθαι, κομισθεῖσαν εἰς Σιδόνα δὲ τὴν χωνεῖαν δέχεσθαι. τινὲς δὲ καὶ τοῖς Σιδονίοις εἶναι τὴν ὕαλτιν ψάρμιον ἐπίτηδείαν εἰς χύσιν, οἱ δὲ πᾶσαν πανταχοῦ χεῖσθαι φασιν. (Compare Eustath. Comm. on Dionys. Periegetes, 912).

³ Strab. 16, 758: ἤκουσα δ' ἐν τῇ Ἀλεξανδρείᾳ παρὰ τῶν δουλουργῶν, εἶναί τινα καὶ κατ' Αἴγυπτον ὕαλτιν γῆν, ἥς χωρὶς οὐχ ὅσον τε τὰς πολυχρόους καὶ πολυτελεῖς κατασκευὰς ἀποτελεσθῆναι, καθάπερ καὶ ἄλλοις ἄλλων μινμάτων δεῖν.

⁴ Plin. N.H. 36, 194: iam vero et in Volturno amne Italiae harena alba nascens sex milium passuum litore inter Cumas atque Liternum, qua mollissima est, pila molave teritur.

supply.¹ But the use of crystal in India to produce an unparalleled quality of glass² is doubtful. Crystal was more valuable than glass, and, as Friedrich observes, it is not probable that it was destroyed to make a less valuable product.³ However, the broken pieces, chips and fragments might have been so used. Yet even so, or if a kind of quartz were meant by crystal, it would still be uncertain whether in antiquity glass was ever manufactured in India.⁴ The alkali most frequently mentioned is nitrum,⁵ a natural soda of some kind⁶ found plentifully in Egypt.⁷ The ashes of certain plants and woods were also used. A scholiast on Aristophanes' Clouds says, "we call hyalos that which has just been burned from a certain herb and melted by fire for the preparation of certain vessels."⁸ Theophilus recommends the use of the

¹Id. 36, 194: iam vero et per Gallias Hispaniasque simili modo harena temperatur.

²Id. 36, 192. auctores sunt in India et crystallo fracta fieri et ob id nullum comparari Indico.

³Friedrich (Rhein. Jahrb. 74, 173) suggests a clear quartz in place of crystal.

⁴Wallace-Dunlop, Glass in the Old World, 106: "Sir G. Birdwood has suggested that when Pliny speaks of Indian glass . . . he probably meant Chinese; a confusion very likely to be made at that time in Rome, especially as the Chinese still use quartz rock at the present day for making glass, and Royle tells us enamellers in India still use cakes of glass imported from China." Kisa, Das Glas im Altert. 1, 105 ff.

⁵Plin. N.H. 36, 191 ff.; Tac. Hist. 5, 7; Aen. Gaz. 552; Isid. Etym. 16, 16, 2 ff.

⁶Blümner, Tech. u. Term. 4, 388.

⁷Plin. 31, 110.

⁸Schol. on Aristoph. Nub. 768: ἄλλως ὕαλον ἡρεῖς πέναντίως τὸ ἐκ βοτάνης τινὸς κεκαυμένον καὶ διὰ πυρὸς τηρόμενον εἰς κατασκευὴν ἀγγείων τινῶν λέγομεν. Salmas. Plin. Exercit. 771 a, G ff.: ex herba vitrum conficere inventum tunc locorum in Graecia tradit. quod hodie sit. ex cineribus filicis exustae admixta, quam soldam vocant, conflatur vitrum sed vilius. filicarios calices vulgo vocamus. at herba illa de qua loquitur interpret Aristoph., quae exurebatur ad vitra conflanda, est herba kali. sic Arabes vocant.

ashes of beech-wood.¹ Heraclius also mentions the use of ashes in the preparation of glass.² There is almost no reference to lime in connection with glass, but probably Pliny includes it when he speaks of the use of shells.³ Besides the necessary ingredients other materials were introduced for the purpose of coloring the glass. Although there are repeated references to colored glass and the imitation of gems, there is little indication among earlier writers what materials were used to produce the different colors. The use of dark substances, such as the Alabandicus stone,⁴ might possibly produce a dark glass. However, the nature of the stone is a matter of dispute.⁵ Among other things Pliny lists magnetic oxide of iron, which would very probably give a dark color, and copper, which was definitely used for coloring.⁶ In late writers,

¹Theophil. Divers. Art. Sched. 2, 1: si sederit animo tuo ut vitrum componas, primum incide ligna faginea multa et exsicca ea. deinde combure ea pariter in loco mundo, et ciueres diligenter colligens, cave ne quicquam terrae vel lapidis commisceas.

²Heracl. op. cit. 3, 7: vitrum efficitur de cineribus, id est, de filicis cinere, et de faina, id est, de parvulis arboribus quae sunt vel crescunt in sylvis. Accipitur autem filix ante Festum S. Johannes Baptistae, et optime siccatur, deinde ad ignem mittitur et fit cinis. Similiter et faina efficietur cinis per ignem. Accipies itaque duas partes de filice, et terciam partem de faina, et simul misces. Heraclius is quoted after Theophilus in this instance because the third book, unlike the other two books of Heraclius, is later than Theophilus (See Heracl. ed. Ilg., p. V).

³Plin. N.H. 36, 192, note 6 below.

⁴Id. 36, 62: e diverso niger est Alabandicus terrae suae nomine, quamquam et Miletii nascens, ad purpuram tamen magis aspectu declinante. idem liquatur igni funditurque ad usum vitri.

⁵Nies, P. W. s.v. Alabandicus.

⁶Plin. 36, 192: mox, ut est ingeniosa sollertia, non fuit contenta nitrum miscuisse; coeptus addi et magnes lapis, quoniam in se liquorem vitri quoque ut ferrum trahere creditur. simili modo et calculi splendentes multifariam coepti uri, dein conchae ac fossiles harenae . . . levibus autem aridisque lignis coquitur addito cypro ac nitro, maxime Aegyptio. Compare Isid. Etym. 16, 16, 3. On the employment of copper for coloring glass. Theophr. de Lapid. 49:

ἰσιωτάτη ἢ τῷ χαλκῷ χυνομένη. πρὸς γὰρ τῷ τύκεσθαι καὶ

such as Heraclius and Theophilus, detailed accounts of the coloring of glass may be found.¹

For mending broken glass either chalk and white of egg,² or sulphur³ were employed.

ρίγνυσθαι καὶ σύναμιν ἔχει περιττὴν ὥστε τῷ κάλλει τῆς
χρῶας ποιεῖν διαφορὰν.

¹Heracl. op. cit. 2, 18 ff.; 3, 1 ff. Theophil. op.cit. 2, 7, 8, 12, 16. In the final form of my study these works will be translated in an appendix.

²Plin. 29, 51: et, ne quid desit ovorum gratiae, candidum ex iis admixtum calci vivae glutinat vitri fragmenta.

³Plin. 36, 199: vitrum sulphuri concoctum feruminatur in lapidem. Iuv. 5, 48: calicem . . quassatum et rupto poscentem sulphura vitro. Scholia Vetera (Iuv. Sat. ed. Heinrich, 1839) on 5, 48: quassatum et rupto: ut solent sulfure calices fractos sive calvariolas componere. sulfura: quia hoc solent vitrum solidare, id est, maltare . There is also a possibility that the cup is so worthless that it is ready to be traded for sulphur, for there seems to have been a practice of trading broken glass for sulphur. Cf. Mart. 1, 41: transtiberinus ambulator, qui pallentia sulphurata fractis permutat vitreis. Stat. Sily. 1, 6, 74: hic plebs scenica quique comminutis permutant vitreis gregale sulphur.

C. Methods

The art of making glass, the hyalourgiké technê,¹ included much more than simply melting together a silicate and an alkali. The sand was made as fine as possible and then mixed with three parts of soda.² Theophilus gives the proportion of one part of sand to two of ashes.³ After the ingredients had been thoroughly mixed, they were put into a glass oven. Unfortunately ancient writers have left little information concerning the glass oven, the Greek kaminos hyelourgikê,⁴ the Latin fornax.⁵ Dioscorides says that "the soot

¹David. Proleg. et in Porphyry. Isogogen. 20, 11 ff.: οἷον ὡς ἐπὶ τῆς ὑαλουργικῆς. ἔαν γὰρ εἴπωμεν ὅτι ὑαλουργικὴ ἐστὶ τέχνη περὶ ὕαλον καταταγινόμενη, τέλειός ἐστιν ὅρος. εἴ τι μὲν γὰρ ὑαλουργικὴ ἐστὶ, τοῦτο τέχνη περὶ ὕαλον καταγινόμενη, καὶ εἴ τι περὶ ὕαλον. καταγινόμενη, τοῦτο τέχνη ἐστὶν ὑαλουργικὴ. πᾶν γὰρ ὑαλουργικῇ μόνῃ ὑποκεῖται ὁ ὕαλος.
Nicephorus Bleimida (Patr. Gr. 142, 697): ὑαλουργικὴ ἐστὶ τέχνη καταγινόμενη περὶ τὴν ὕαλον.

²Plin. N.H. 36, 194: pila molave teritur. dein miscetur III partibus nitri pondere vel mensura. One would naturally expect that three parts equalled three-fourths (Harper's Lex. s.v. pars, II, G), but this proportion of sand and soda although it can be fused, does not make glass (See Gelstharp and Parkinson, The Limits of Proportions of Soda-Lime Glasses in Tr. Am. Cer. Soc. 16, 1914, 109 ff.).

Froehner, La Verrerie, 27, takes this passage to mean three parts of soda to nine of sand, basing his opinion on the theory that the duodecimal system was used. This sounds extremely attractive in view of the fact that it makes a possible proportion of sand and alkali, but in no place have I been able to find pars used as one twelfth.

³Theopil. op. cit. 2, 4: deinde tollens duas partes cinerum de quibus supra diximus, et tertiam sabuli diligenter de terra et lapidibus purgati, quod de aqua tuleris, commisce in loco mundo.

⁴Geopon. 20, 16: κριοῦ τὸ μόριον βαλὼν εἰς ὀρόριον ὡμόν, καὶ ἄλλο ὀρόριον ἐπικαλύψας πύλησον, ὥστε μὴ ἔχειν ἀνάπνοϊαν μηδαμόθεν, καὶ δὸς εἰς κάρινον ὑαλουργικὴν ὅπτηθῇται ἀπὸ πρῶτῃ ἕως ἐσπέρας, καὶ εὐήσεις αὐτὸ μαλακὸν γεγονὸς ὡς τυρόν.

⁵Plin. N.H. 36, 193.

which the painters use is taken from the places where glass is made.¹
 The poor people seem to have gone to the glass-houses to get warm.²
 A fantastic story is told of a boy who was thrown into an oven by a Jew, but miraculously rescued.³ None of these references, however, give any idea of the construction of the oven. But in the works of Theophilus⁴ and Heraclius⁵ there are elaborate descriptions of the different ovens for cooking, cooling, and reheating. The kind of fuel used was of great importance for the production of the proper degree of heat. Pliny says that the wood should be light and dry.⁶ Both tamarisk⁷ and papyrus⁸ were suitable for the purpose.

As soon as the mixture of sand and soda began to get hot, it was stirred so that it would not liquify and congeal immediately.⁹ There were windows in the glass-ovens, through which the workmen could carry on such operations.¹⁰ But as soon as it did liquify,

¹ Diosc. 5, 181: ἀσβόλη, ἣ οἱ ζωγράφοι χρῶνται, λαμβάνεται μὲν ἐκ τῶν θελουργείων. Compare Paul. Aeg. 106^v, 10.

² Leont. Vita S. Symeon. Sali (Patr. Gr. 93, 1736 D): ἦν δὲ πάλιν ἅπαξ καθ' ἡμέρας μετὰ ἀδελφῶν, καὶ θερμαινόμενος πλησίον τοῦ καμινίου τοῦ ὑελέφου.

³ Michael Glycas (Script. Hist. Byz. 27, 506); Georg. Cedremus (Script. Hist. Byz. 34, 687).

⁴ Divers. Art. Sched. 2, 1, 2, 3, 22.

⁵ De Color. 3, 7. Froehner, op. cit. 27; Blümner, op. cit. 4, 389.

⁶ Plin. N.H. 36, 193.

⁷ Plut. Quaest. Conv. 3, 19, 3, 658 D: πρὸς δὲ τὴν τοῦ ὑέλου ῥάλαξιν καὶ τύπωσιν εὐάρμοστον εἶναι δοκεῖ τὸ μυρίκινον.

Macrob. 16, 23: qui vitro soluendo formandoque curant, de arbore, cui myricae nomen est (igne utuntur).

⁸ Cass. Felix. de Med. 20: papyrus vitriariorum carnosum, id est quod non fuerit fragile vel flacidum. Olympiod. on Arist. Meteor. 2, 228: ὅθεν πολλὰ φροντὶς παρὰ τοῖς ὑελέφαις τοῦ τινάσσειν τὴν πάπυρον, i.e., so that a salamander would not fall in the fire and put it out.

⁹ Theophil. op. cit. 2, 4.

¹⁰ Heracl. op. cit. 3, 7.

it was transferred to other ovens where it was allowed to form a mass called ammonitrum, i.e., sand-natron. This was reheated until there resulted a pure, transparent glass,¹ or colored glass, in case some material or materials had been added for that purpose.² Then after the proper tempering, the glass was ready for fashioning into objects.³ At first everything was formed by hand, and the discovery of blowing glass must have brought a great change both in the number of workmen required and in the number and variety of vessels produced.⁴ In some instances the glass was worked upon a lathe, in others it was elaborately carved like silver.⁵

¹Plin. N.H. 36, 194: ac liquata in alias fornaces transfunditur ibi fit massa, quae vocatur hammonitrum, atque haec recoquitur et fit vitrum purum ac massa vitri candidi.

²Id. 36, 193: continuis fornacibus ut aes liquatur, massaeque fiunt colore pingui nigricantes. Theophilus, Divers. Art. Sched. 2, 7 ff.

³Mesomedes (Anth. Pal. 16, 323) quoted on page 82. Theodoretus, de Provid. 4, 39 (Patr. Gr. 83, 617 A ff.): πόθεν ἔμαθε φύσιν υἱέλου; τίς αὐτὸν τῆς ψάρμον τὴν διαφοράν ἐπαίδευσε; τίς αὐτὸν ἐδίδασκε τὴν τοιάνδε ψάρμον τῷ πυρὶ παραδίδοσθαι, καὶ ὅπως, καὶ ἐπὶ πόσον; καὶ τὴν συνεχῇ μὲν χωρίζειν, τὴν χωριστὴν δὲ εἰς συνεχὲς ἀχώριστον μεταβάλλειν; πῶς ἔγνω διαπλάττειν ἐκ ταύτης, πυρὶ καὶ πνεύματι συνεργῶ κεχρημένος, ἐκπωμάτων εἶδη μυρία, φιάλας, καὶ κύλικας, καὶ βομβύλους, καὶ ἀρφορίσκους, καὶ ἑπιπλια, καὶ ἕτερα σκεύη πρὸς πᾶσαν χρείαν βρωτῶν ἐπιτήδεια;

⁴Sen. Epist. 90, 31: cuperem Posidonio aliquem vitrearium ostendere qui spiritu vitrum in habitus plurimos format, qui vix diligenti manu effingerentur. Vopiscus, Saturninus, 8, 6: alii vitrum conflant. Pallad. Schol. on Hippocr. 2, 222: ὁ γὰρ υἱάλωψ ἄρα τῷ φυσῶν καὶ πόρον ποιεῖ τινα καὶ σχῆμα.

⁵Plin. N.H. 36, 193: ex massis rursus funditur in officinis tinguiturque, et aliud flatu figuratur, aliud torno teritur, aliud argenti modo caelatur. Apul. Met. 2, 19: hic vitrum fabre sigillatum.

D. Kinds of Glass

There is no definite reference in Greek literature to the earliest form of glass-making, the art of glazing. However, the silver color given to a variety of the pottery of Naucratis may have been produced in that way.¹ Glass-paste is mentioned in Homer, as has been discussed under kyanos.²

The chief characteristic of hyalos, as has been shown, was transparency. The glass most highly prized was that which most closely resembled crystal.³ The similarity probably led to colorless glass sometimes being called simply krystallos in Greek⁴ and crystallum⁵ in Latin, while objects made of it would be designated as crystallina.⁶ In most instances it is impossible to determine

¹Athen. 9, 480 D: διαφοροὶ δὲ κύλικες γίνονται καὶ ἐν τῇ τοῦ συσσί, τοῦ ἑμῶν Ἀθηναίου πατρίδι Ναυκράτει. εἰσὶ γὰρ φικλώσεις κέν, οὐ κατὰ τὸρνον δ' ἄλλ' ὥσπερ δακτύλῳ πεποιημέναι, καὶ ἔχουσιν ὥτα τέσσαρα, πυθμένα εἰς πλάτος ἐκτεταμένον, καὶ βάπτονται εἰς τὸ δοκεῖν ἀργυρεῖν.
See Blümner, Tech. u. Term. 2, 97.

²See above, p. 8ff.

³Plin. 36, 198: maximus tamen honos in candido tralucentibus, quam proxima crystalli similitudine.

⁴See above, p. 58ff.

⁵Mart. 9, 22: nec labris nisi magna meis crystallata terantur. 10, 66: quis potius cyathos aut quis crystallata tenebit. 12, 74: dum tibi niliacus portat crystallata cataplasma, accipe de circo pocula Flaminio.

⁶Sen. de Benef. 7, 9, 3: video istis crystallina, quorum accendit fragilitas pretium. de Ira, 3, 40, 2: fregerat unus ex servis eius crystallinum. Mart. 1, 53: sic Arretinae violant crystallina testae. 9, 59: et turbata brevi questus crystallina vitro. 14, 111: Crystallina- Frangere dum metuis, franges crystallina peccant, securae nimium sollicitaeque manus. Iuv. Sat. 6, 155 ff.: grandia tolluntur crystallina, maxima rursus myrrhina. Theonas, Epist. 6 (Patr. Gr. 10, 1572 D): simili modo ille agat, cuius fidei credita sunt vasa argentea, aurea, crystallina, vel murrhina, escaria vel potoria.

whether glass or crystal is meant, but especially among the Roman poets cups of crystallum are mentioned very frequently, while we know that crystal was rare and, as far as I am aware, no vessel of it has come down, although numerous wonderfully wrought glass cups and vases have been preserved. The fact that some of the vessels are brought from Egypt, the greatest glass manufacturing center, makes it seem all the more probable that crystallum was used for glass and crystallina for objects made of glass.

Nearly every kind of gem was imitated in colored glass.¹ Very likely glass is sometimes understood by the name of a particular gem² or simply by the word gem itself.³ Glass of different colors, the Millefiori or glass mosaic, was called morria in Greek, murra in Latin.⁴ Obsidian, the black, natural volcanic glass, is classed with glass by Pliny.⁵

¹Plin. N.H. 35, 48: admixtis vitreis gemmis. 36, 198: fit et album et murrina aut hyacinthos sappirosque imitatum et omnibus aliis coloribus. Isidor. Orig. 16, 3: tinguitur etiam multis modis, ita ut iacinthos sappirosque et virides imitetur et onyches vel aliarum gemmarum colores.

²Hdt. 2, 44: ἐν αὐτῇ ἦσαν στήλαι δύο, ἡ μὲν χρυσοῦ ἀπέφθου, ἡ δὲ γραβάδος λίθου λάμποντος τὰς νύκτας μέγας.
See Rawlinson, Hdt. 2, 70, 8. Mart. 10, 49: cum potes amethystinos trientes et nigro madeas Opimiano.

³Vergil, Georg. 2, 506: hic petit excidiis urbem miserosque penatis, ut gemma bibat et Sarrano dormiat ostro. Mart. 11, 11: te potare decet gemma. 12, 40: gemma vis ludere, vincor. 14, 20: Calculi-Insidiosorum si ludis bella latronum, gemmeus iste tibi miles et hostis erit. 14, 94: nostra neque ardenti gemma feritur aqua.

⁴See above, page 62 ff.

⁵N.H. 36, 196 ff.: in genere vitri et obsiana numerantur ad similitudinem lapidis, quem in Aethiopia invenit Obsius, nigerrimi coloris, aliquando et translucidi, crassiore visu atque in speculis parietum pro imagine umbras reddente. gemmas multi ex eo faciunt; vidimus et solidas imagines divi Augusti capaci materia huius crassitudinis, dicavitque ipse pro miraculo in templo Concordiae obsianos IIII elephantos. remisit et Tiberius Caesar Heliopalitarum

Aside from the different kinds of glass, there are glass vessels which have special names depending upon their style. Pliny says that there was a variety of glass goblet called petrotos.¹ Probably the alassontes,² cups of changeable color, from Egypt were of opalescent glass.³ Toreumata, as used by Martial,⁴ seem to have been cups of glass carved in relief, probably like the Portland vase and Naple's amphora, although those to which he refers are not always of superior workmanship.⁵ The diatreta mentioned also by Martial⁶ are shown by Ulpian in the Digest⁷ to have been especially fragile. Such delicate work required specialized workmen, the diatretarii.⁸ With the present evidence it is impossible to prove

caerimoniis repertam in hereditate Sei eius, qui praefuerat Aegypto, obsianam imaginem Menelai, ex qua apparet antiquior materiae origo, nunc vitri similitudine interpolata. Xenocrates obsianum lapidem in India et in Samnio Italiae et ad oceanum in Hispania tradit nasci. fit et tincturae genere obsianum ad escaria vasa et totum rubens vitrum atque non tralucens, haematinum appellatum.

¹N.H. 36, 195: sed quid refert, Neronis principatu reperta vitri arte, quae modicos calices duos, quos appellabant petrotos, H S VI venderet?

²Vopisc. Saturn. 8, 10: calices tibi alassontes versicolores transmissi.

³Becker-Göll, Gallus, 2, 382; Froehner, La Verrerie, 46.

⁴Mart. 11, 11: tolle, puer, calices tepidique toreumata Nili. 12, 74: nullum sollicitant naec, Flacce, toreumata furens, et nimium calidis non vitiantur aquis. 14, 94: nos sumus audacis plebeia toreumata vitri. Cf. Clem. Alex. Paedag. 2, 3, 35: ναὶ τὴν καὶ τορευτῶν περίεργος ἐφ' ὅλῳ κενοδοξία εἰς ὁρατοῦν διὰ τέχνης ἐτοιμοτέρα δεδιέναι.

⁵Blümner, Tech. u. Term. 4, 404; Kisa, Das Glas, 2, 590.

⁶12, 70: O quantum diatreta valent et quinque comati.

⁷Dig. IX, 2, 27, 29: si calicem diatretum faciendum dedisti, si quidem imperitia fregit, damni iniuria tenebitur: si vero non imperitia fregit, sed rimas habebat vitiosas, potest esse excusatus.

⁸Cod. Theod. 13, 4, 2. Cod. Just. 10, 66, 1.

that the diatrete were of glass, but usually the name is thought to refer to the network vessels such as the vases in Cologne¹, which Kisa, however, regards as simply one form of diatrete.²

The use of glass vessels decorated with gold is mentioned by Athenaeus³ in connection with the banquet of Ptolemy Philadelphus. In the Church of Sancta Sophia the gold colored glass used to cover the walls and ceiling was probably in the form of mosaic so common in the early churches.⁴ Many objects have been found, especially in the catacombs, with designs in gold between two layers of transparent glass. The method of making these is fully described by Theophilus.⁵

¹Blümner, Tech. u. Term. 4, 400 ff.

²Kisa, Das Glas, 2, 624 ff.

³5, 199 F: καὶ κυλικεῖα δὺο καὶ ὑάλινα διαχρύσα δὺο.

⁴Anon., Διήγησις περὶ τῆς Ἁγίας Σοφίας (Script. Orig. Const. 1, 15 (93, 6 ff.): ποὺς δὲ ὁρόφους πάντας... κατεχρύσωσι ἐξ ὑελίνου χρυσοῦ λεπτοτάτου.

⁵Theoph. 2, 13: De vitreis scyphis, quos Graeci auro et argento decorant. Graeci vero faciunt ex eisdem sapphireis lapidibus pretiosos scyphos ad potandum, decorantes eos auro hoc modo. Accipientes auri petulam, de qua superius diximus, formant ex ea effigies hominum, aut avium, sive bestiarum, vel foliorum, et ponunt eas cum aqua super scyphum in quocumque loco voluerint; et haec petula debet aliquantulum spissior esse. Deinde accipiunt vitrum clarissimum, velut crystallum, quod ipsi componunt, quodque mox, ut senserit colorem ignis, solvitur, et terunt diligenter super lapidem porphiriticum (porphireticum M) cum aqua, ponentes cum pincello tenuissime super petulam per omnia, et cum siccatum fuerit, mittunt in furnum, in quo (ubi M) fenestrae vitrum pictum coquitur, de quo postea dicemus, supponentes ignem et ligna faginea in fumo omnino siccata. Cumque viderint flammam scyphum tandiu pertransire donec modicum ruborem trahat, statim ejicientes ligna, obstruunt furnum, donec per se frigescat; et aurum nunquam separabitur.

In the lexica¹ the Thêrikleios is defined as a glass cup. Athenaeus gives a very detailed account of this cup classifying it as a form of the kylix,² but he says there was also another kind called the Thêrikleios krater.³ According to him the cup received its name from Thericles, a Corinthian of the time of Aristophanes, originally a potter, who was said to be the first maker of this kind of cup.⁴ Since Thêrikleios seems to designate a particular form of cup whether of clay,⁵ wood,⁶ gold,⁷ or glass,⁸ it will be treated at a later time among the forms of glass vessels in a chapter on the uses of glass.

¹ Cyrillos, gloss (Hesych. ed. Schmidt, 4, 341); Photius: Θηρίκλειον· ποτήριον δέλλινον. Bachmann, Anecd. Gr. 1, 256, 17; Suidas: Θηρίκλειον· ποτήριον δάλλινον. Etym. Magn. 451, 27: Θηρίκλειον κύλικα· ποτήριον δέλλινον, τὸ τοῦ Θηρικλέους ποτήριον. Zonar. Lex. 1043: Θηρίκλειον· ποτήριον δέλλινον.

² Athen. 11, 470 E: Θηρίκλειος· ἡ κύλιξ αὕτη ἐγκάθηται περὶ τὰς λαγόνas ἐκάνως βαθυνομένη ὥτ' αὖτε ἔχει βραχεὰ ὡς ἡ κύλιξ οὔσα, κτλ.

³ Athen. 11, 472 A: καλεῖται δέ τις καὶ Θηρίκλειος κρατήρ.

⁴ Athen. 11, 470 F: κατασκευάσαι δέ λέγεται τὴν κύλικα ταύτην Θηρικλῆς ὁ Κορίνθιος κεραφεύς, ἀφ' οὗ καὶ τοῦνομα ἔχει, γεγονώς τοῖς χρόνοις κατὰ τὸν κωμικὸν Ἀριστοφάνη.

⁵ Athen. 11, 471 D: καὶ Εὐβουλος ἐν μὲν Δόλῳ... καθαρώτερον γὰρ τὸν κέραμον εἰργαζόμενῃ ἢ Θηρικλῆς τὰς κύλικας, ἡνίκ' ἦν νέος. Id. 11, 472 D: Θεόφιλος δ' ἐν Βοιωτίᾳ τετρακότυλον δέ κύλικα κεραφεῶν τινὰ τῶν Θηρικλείων, κτλ.

⁶ Theophr. Hist. Plant. 5, 3, 2: μέλαν δὲ σφόδρα καὶ πυκνὸν τὸ τῆς τερμίνθου· περὶ γοῦν Συρίαν μελάντερόν φασι εἶναι τῆς ἐβένου· καὶ ἐκ τούτου γὰρ καὶ τὰς λαβὰς τῶν ἐγχειριδίων τοιεῖσθαι, τορνεύεσθαι δὲ ἐξ αὐτῶν καὶ κύλικας Θηρικλείους, ὥστε μηδένα ἂν διαγνῶναι πρὸς τὰς κεραφεάς.

⁷ Athen. 11, 472 C: Πολέμων δ' ἐν πρώτῳ περὶ τῆς Ἀλῆνησις Ἀκροπολεως οὐδετέρως ὠνόμασεν εἰπων· τὰ χρυσᾶ Θηρίκλεια ὑπόφυλα Νεόφυλα Νεοπτόλεμος ἀνέθηκεν.

⁸ See above, note 1.

As glassmaking became a more developed art, the fragility of the substance must have been felt as a great disadvantage. There is a story told of a workman who invented a flexible glass, but was beheaded by Tiberius so that this secret should not become known and cause the precious metals to depreciate in value.¹ Since Pliny, however, who lived during the reign of Tiberius and who was besides not unduly sceptical, plainly disbelieved the account, ("told with more frequency than truth" is his expression), it may be dismissed as a bit of malicious fiction.

¹Petron. 51: fuit tamen faber qui fecit phialam vitream, quae non frangebatur. admissus ergo Caesarem est cum suo munere, deinde fecit reporrigare Caesarem et illam in pavimentum proiecit. Caesar non pote validius quam expavit. at ille sustulit phialam de terra; collisa erat tamquam vasum aeneum; deinde marticulum de sinu protulit et phialam otio belle correxit. hoc facto putabat se solium Jovis tenere, utique postquam Caesar illi dixit: "numquam alius scit hanc condituram vitreorum?" vide modo. postquam negavit, iussit illum Caesar decollari: quia enim, si scitum esset, aurum pro luto haberemus.

Plin. N.H. 36, 195: ferunt Tiberio principe excogitato vitri temperamento, ut flexile esset, totam officinam artificis eius abolitam, ne aeris, argenti, auri metallis pretia detraherentur, eaque fama crebrior diu quam certior fuit.

Dio Cassius, 57, 21, 7: μετὰ δὲ ταῦτα προσελθόντος οἱ αὐτοῦ καὶ ἱκετεῖαν ποιουμένου, καὶ τούτῳ ποτήριόν τι δαλοῦν καταβαλόντος τε ἐξεπίτηδες καὶ ἄθραυστον παραγρῆμα ἀποφήναντος, ὥς καὶ συγγνώμης διὰ τοῦτο τευξομένου, καὶ ἀπέκτεινεν αὐτόν.

Isid. Orig. 16, 16, 6: ferunt autem sub Tiberio Caesare quendam artificem excogitasse vitri temperamentum, ut flexibile esset et ductile. qui dum admissus fuisset ad Caesarem, porrexit phialam Caesari, quam ille indignatus in pavimentum proiecit. artifex autem sustulit phialam de pavimento, quae complicaverat se tamquam vas aeneum; deinde marculum de sinu protulit et phialam correxit. hoc facto Caesar dixit artifice: 'Numquid alius scit hanc condituram vitrorum?' postquam ille iurans negavit alterum hoc scire, iussit illum Caesar decollari, ne dum hoc cognitum fieret, aurum pro luto haberetur et omnium metallorum pretia abstraherentur; et reversa, quia si vasa vitrea non frangeretur, melius essent quam aurum et argentum.

E. Glass Workers

Strabo¹ is the first to mention the hyalourgos, and it was from the glass workers of Alexandria that he received his information about Egyptian glass. One of the first vitrearum mentioned in Latin literature is the fabulous inventor of unbreakable glass.² In late Greek writers several stories are told of individual workmen. Michael Glycas and Georgius Cedrenus tell of a Hebrew hyelepsos in the reign of Justin who was executed for throwing his son into the glass furnace because he partook of Christian bread.³ In the next century the conversion of a Jewish glass worker is related by Leontius. As the people sat about the furnace warming themselves, a dispute arose between the Jew and the Christians. Saint Symeon Salus, as the story goes, began miraculously to cause the breaking of the vessels which were about the room and continued

¹Strabo, 16, 758.

²See above, page 79.

³Michael Glycas, Annal. 4 (Script. Hist. Byz. 27, 506): κατ' ἐκεῖνο καιροῦ ἀνεφάνη καὶ ὁ υἱοψὸς Ἰουδαῖος ὁ τὸ παιδίον αὐτοῦ διὰ τὸ ἐνωθῆναι χριστιανοῖς παιδίοις καὶ φαγεῖν ἀπὸ τῆς μυστικῆς τραπέζης βαλὼν εἰς τὸν κάμινον, εἰ καὶ οὐκ ἐφλέχθη τῆς θεοτόκου φυλαγᾶς αὐτό, καθὰ δὴ τὸ παιδίον διεβεραίουτο. ταύτη τοι καὶ τοῦ τοιούτου θαύματος διὰ τοῦ πατριάρχου Μηνᾶ γνωρισθέντος τῷ βασιλεῖ, μετακαλεῖται ὁ Ἰουδαῖος. παλλὰ τοίνυν παραινέσεις καὶ μὴ πεισθεὶς τῆς οἰκείας ἀποστερεῖται γωῆς ὡς φονεὺς τοῦ ἰδίου παιδός.

Georgius Cedrenus, Hist. Compend. (Script. Hist. Byz. 34, 686 ff.): ἐπὶ τούτου τοῦ εὐσεβεστάτου Ἰουστινίου Ἰουδαῖός τις ἐν τῇ πόλει υἱοψὸς παιδίον ἐκέκτητο... ὁ δὲ δόλιος ἐκεῖνος θῆρ σφόδρα μανείς, μετὰ τὸ ἀριστῆσαι λαβὼν τὸ παιδίον καὶ ἀπελθὼν εἰς τὸ ἐργαστήριον αὐτοῦ ἔρριπεν αὐτὸ εἰς τὴν κάμινον καὶ κλείσας τὴν θύραν ἀνεχώρησεν... ὁθεν καὶ προσέταξεν αὐτὸν ἀνασκολοπισθῆναι ὡς φονέα γενόμενον τοῦ ἰδίου παιδίου.

to do so until the glass worker had crossed himself.¹ Joannes Moschus mentions a workman who had been blinded by the fire.²

In inscriptions the names of a few glass workers have been preserved. Euphrasios is mentioned on a Jewish or Christian sepulchral inscription in Athens.³ In Mauretania there was a vitriarius Antas whose name occurs upon the sepulchral inscription of his little son.⁴ Julius Alexander was likewise a native of Africa, a Carthaginian citizen, who was evidently living at Lyons at the time of his death.⁵ Perhaps a glass manufacturer of Gaul had called him to that place.

There are other references in literature and the laws which give glimpses of the duties and social standing of glass

¹Leontius (Patr. Gr. 93, 1736 D): ἦν δὲ πάλιν ἅπας καθήμενος μετὰ ἀδελφῶν, καὶ θερμαίνόμενος πλησίον τοῦ καμινίου τοῦ δελεψοῦ. ἦν δὲ δελεψὸς Ἑρραῖος, καὶ λέγει τοῖς πτωχοῖς παίζων, κτλ.

²Joannes Moschus, Pratum Spirituale (Patr. Gr. 87, 2932 A): οὐ πῶς γέγονας τυφλός; ἀπεκρίθη καὶ κενὸς λέγων· ὁ αλοψὸς ἦρην τὴν τέχνην, καὶ ἐκ τοῦ πυρὸς ἐπίχυσιν ἔσχον οἱ δύο ὀφθαλμοί, καὶ ἐτυφλώθην.

³I G III 3436: Κυρηναῖον Εὐφρασίου οἰαλᾶ | κέ Γενναδίας.
See above, page 43.

⁴C I L VIII 9430: Saburrio, Antae vitriari et Paulas (=ae) f(i)lius), vixit menses sex.

⁵C I L XIII, 1,1,2000: et · memoriae · aeterne · Iuli. Alexsandri natione Afri · civi Carthaginiensi · omni · optimo · opifici · artis · vitriae · qui vix · anos LXXV menses · V · dies · XIII · sene · ulla lesione · animi cum · coniuge sua · virginia cum qua · vix sit · annis XXXVIII · ex qua creavit · filio VII et eiliam (sic) ex quibus · his omnibus · ne potes · vidite · deos supest (sic) ites · sibi · reliquit hunc tumulum · ponendum CV raverunt · Numonia · Bellia · uxor · et · Iulius · Felix · filius · et Iulius Galonius · filius · et · Numonia · Belliosa · filia item nepote S eius Iulius · Auct?us · Iulius · Felix · Iulius Alex? sander Iulius Galonius? Iulius Leontius Iulius Gali.... Iulius · Eonius · P/P · Cyri- et sub ase dedicaverunt.

workers in general. If papyrus were used for fuel, it was thought best for the workmen to shake the stalks so that a salamander would not fall into the fire and put it out.¹ Of a much earlier date is the epigram of Mesomedes,² which describes the making of glass and the handling of it. "The workman having quarried it, brought the glass and put in the fire the mass hard as iron, and the glass, set afire by the all-devouring flames, ran out melted like wax. And to men it was a marvel to see a trail flowing from the fire and the workman trembling lest it should fall and break; and on the points of the double forceps he put the lump." A scholiast on Hippocrates³ says that the workman by blowing produces both the opening and the shape of the vessel.

Under Constantine exemptions were granted to many artificers, including the vitrearii and diatretarii, that they might become more skilled in their art and see to the training of their sons.⁴ In the Digest⁵ there is an edict for the punishment of

¹Olympiodorus on Arist. Meteor. 2 (Ideler, 228): ὅθεν πολλὴ φροντίς παρὰ τοῖς ὑελέφαις τοῦ τινάσσειν τὴν πάπυρον.

²Anth. Pal. 16, 323: τὰν ὑέλον ἐκόριξε κόψας ἐργάτας ἀνὴρ
δὲ πῦρ ἔθηκε βῶλον, ὡς σίδηρον εὐσθενῇ. | ἅ δ' ὑέλος, οἷα κηρός, |
ἔφεχετο, παρ' ἀνοισί | φλοῖν ἐκπορευμένα | θαῦρα δ' ἦν ἰδεῖν
πρὸ τοῖς ὀφθαλμοῖς ἐκ πυρὸς ῥέοντα, | καὶ τὸ ἐργάτην τρέμοντα, |
τὴν πεσὼν διαρραγῇ. | ἐς δὲ διπτύχων ἀκρὰς | χυλίων
ἔθηκε βῶλον.

Translation by W. R. Paton.

³Palladii Schol. on Hippocr. (Dietz, 2, 222): ὁ γὰρ ὑάλωψ ἄμα τῷ φυσᾶν καὶ πόρον ποιεῖ τινα καὶ σχῆμα.

⁴Cod. Theod. XIII, 4, 2: Imp. Constantinus A. ad Maximum pp. Artifices artium brevi subdito comprehensarum per singulas civitates morantes ab universis muneribus vacare praecipimus, si quidem ediscendis artibus otium sit accommodandum, quo magis cupiant et ipsi peritiores fieri et suos filios erudire. D IIII non. Aug. Feliciano et Titiano cons. [a. 337]... diatretarii ... vitriarii. This is repeated in Cod. Just. X, 66, 1, with slight variations in spelling, i.e., diatritarii V... vitrearii.

⁵Dig. IX, 2, 27, 29.

diatretarii who through carelessness break the goblets intrusted to them, but protecting workmen who had received material containing flaws. Constantinus Harmenopulus¹ in a compendium of laws drawn up in the fourteenth century quote extracts from Julian of Ascalon, who is otherwise unknown, but he must have lived before the Arab conquest of Palestine in 636. This edict states that workers in glass and iron should not carry on their business in the city, but if that is necessary, the workshops should be in remote and sparsely populated parts of the city to prevent sickness and the destruction of property by fire.

¹Hexabiblos, 2, 4, 19: ἐπαρχικὸν περὶ ὑελουργῶν (ἐλουργῶν Η) καὶ σιδηρουργῶν. ὑελουργοὺς (ὕελρυργὸς Η) καὶ σιδηρουργοὺς τοὺς ἐργαζομένους τὰς ἀξίνας καὶ τὰς ἄρας· καὶ τὰ τοιαῦτα μεγάλα ὄργανα, καὶ ἀνδριαντοὺς πλάστας οὐ χρὴ ἐν αὐταῖς ταῖς πόλεσι τὰ τοιαῦτα ἐργάζεσθαι· εἰ δὲ ἀνάγκη τις γένηται τούτους κατοικεῖν τὰς πόλεις καὶ τὰς τούτων ἐργασίας ἐν αὐταῖς γίνεσθαι, εἰς τοὺς ἀπωκισμένους καὶ ἰδιόχοντας τῶν πόλεων τόπους δεῖν ταύτας ἐργάζεσθαι· πολὺς γὰρ ὁ ἀπὸ τοῦ πυρὸς πέλων κίνδυνος τοῖς οἰκήμασι καὶ τοῖς σώμασι συνεχῆς λοιμὸς γίνεται.

F. Manufacturing Centers

Natural resources greatly influenced the location of manufacturing centers. Egypt possessed both sand and nitrum, and it is, therefore, not surprising that the first certain mention of glass in Greek and in Latin is in connection with that country. Herodotus tells of the sacred crocodiles wearing earrings of glass.¹ In the Periplus of Scylax glass is designated simply as 'Egyptian stone.'² Theophrastus says that the Egyptians made an artificial kyanos,³ which has been identified with glass-paste such as that of the frieze of Tiryns.⁴ Martial speaks of the toreumata of the Nile⁵ and again of the fleet of the Nile bringing crystalla.⁶ In a letter of the Emperor Hadrian⁷ the blowing of glass is mentioned, while the alassontes referred to in the same letter were probably of glass.⁸ Under the Emperor Aurelian a tax was put on glass brought from Egypt to Rome.⁹ Even among the various kinds of darts, found chiefly among the Egyptians, those of glass also occurred.¹⁰

¹Hdt. 2, 69.

²Scyl. Peripl. 112.

³Theophr. de Lapid. 55.

⁴See above, page 8.

⁵Mart. 11, 11.

⁶Mart. 12, 74.

⁷Vopisc. Saturnin. 8 ff.

⁸See above, page 76.

⁹Vopisc. Aurel. 45: vectigal ex Aegypto urbi Romae Aurelianus vitri chartae lini stuppae atque anabolicas species aeternas constituit.

¹⁰Paul. Aeg. Chirurgia, 348: αὐτὰ τὰ βέλη... δάδινα... τοσαύτη γὰρ τις διαφορά γὰρ ἡλίστα παρ' Αἰγυπτίοις εὕρεται.

Alexandria was one of the greatest glass manufacturing centers of antiquity. Cicero¹ is the first to mention glass that was imported from there. And it was workmen of that city who gave Strabo his information about the excellent Egyptian sand.² Athenaeus had heard that in Alexandria they imitated every possible kind of earthenware cup in glass.³ Demetrius⁴ uses Alexandrian glass. In repeating the description of burial in glass as given by Herodotus and Ctesias, Diodorus⁵ adds that there was plenty of glass for all because there was a great deal of it made in Aethiopia. Although the story itself is probably false (see above, page 20ff), at the time of Diodorus glass from that part of the world was well known. The glass and myrrhine for export to the Berbers, mentioned in the Periplus of the Red Sea, were made at Thebes.⁶

There was also excellent sand in Phoenicia along the Belus river and according to some at Sidon likewise.⁷ In the early empire this city was already an important manufacturing center, for Pliny calls Sidon the artifex vitri,⁸ and ascribes to her the invention of the mirror⁹ (i.e., of glass). Lucian¹⁰ uses Sidonian

¹Pro Rabir. Post. 14, 40: 'dominatus est enim,' inquit, 'Alexandriae'. . fallaces quidem et fucosae e chartis et linteis et vitro velatae; quibus cum multae naves refertae fuissent, una non completa fuit parva.

²Strabo, 16, 758.

³Athen. 11, 784 C: κατασκευάζουσι δὲ, φησὶν, οἱ ἐν Ἀλεξανδρείᾳ τὴν ὕαλον μεταρρυθμίζοντες πολλὰς καὶ ποικίλαις ἰδέαις ποτηρίων, παντὸς τοῦ πανταχόθεν κατακομιζομένου κεράμου τὴν ἰδέαν μιμούμενοι.

⁴Hieracosophion, 271, 281.

⁵Diod. 2, 15.

⁶Peripl. Maris Erythr. 6.

⁷See above, page 7. ⁸Plin. N.H. 5, 76. ⁹Plin. N.H. 36, 193.

¹⁰Amores, 26: τὸ δ' ἄλλο σῶμα κησ' ἀμαρῇ τριχὸς αὐταῖς ὑποφωσμένης ἡλέκτρον, φασὶν, ἢ Σιδωνίας ὕαλου διαφεγγέστερον ἀπαστρέπτει.

glass as a standard of transparency. By Sidonian cup Athenaeus¹ might possibly mean a cup of glass,² since it was that for which the city was so noted.

Reports of the manufacture of glass in the far East are less trustworthy. Pliny praises most highly the glass of India which, he says, was made of broken crystal. However, it is extremely doubtful if glass was made in India.³ When Propertius⁴ writes of 'murrhine cups baked in Parthian ovens,' it may be no more than a poetical way of saying that they came from the near East, and, if so, the expression would indicate that the manufacture of glass had in the first century spread from Phoenicia as far as Mesopotamia.

In the time of Strabo very clear, crystal-like glass was being manufactured at Rome. This glass was very cheap in price.⁵ In the first region, which lay between the Aventine and Caelian there was a vicus vitrarius,⁶ the exact location of which is not known.⁷ It was in connection with the fine white sand of the Volturnus that Pliny gave his description of the process of making

¹Athen. 11, 468 C: ὅλλοι δὲ τὸ ἐν κύκλῳ τύπους ἔχον οἶον σακτούλους, ἢ τὸ ἔχον ἐξοχὰς οἶα τὰ Σιδωνία ποτήρια, ἢ τὸ λεῖον.

²Blümner, Term. u. Tech. 4, 381, 3.

³See above, page 68.

⁴Prop. 4, 5, 26.

⁵Strabo, 16, 758: καὶ ἐν Ῥώμῃ δὲ πολλὰ παρὲρ ἰσκέσθαι φασὶ καὶ πρὸς τὴν ἱερῶν τῆς κατασκευῆς, καθάπερ ἐπὶ τῶν κρυσταλλφανῶν. ὅπου γὰρ καὶ τρυβλίον χαλκοῦ πρῶτον καὶ ἐκπωρᾶτιον ἔστιν.

⁶Reg. urb. reg. 1, 3, 5 (Curios, urb. reg. 1, 2, 5) in Urlichs, Cod. urb. Rom. top.: Regio I. Porta Capena. . vicum vitrarium.

⁷Jordan, Topogr. d. St. Rom. 1, 3, 219.

glass.¹ In Puteoli there was a clivus vitriarius,² which would lead one to think that glass was made there. The name of the town Vitricium,³ modern Verres,⁴ may have nothing to do with vitrum, but it is conceivable that as the knowledge of glass making spread to the provinces, a factory was established in northern Italy and the town received its name from its principal industry.

In the provinces of Gaul and Spain, according to Pliny,⁵ glass was made in the same way as in the vicinity of Cumae. But Strabo does not speak very highly of the glass vessels which the Britons imported from Gaul.⁶ One of the particular places where glass was made was Lugdunum. A sepulchral inscription has been found here of a glass worker from Carthage.⁷ As has been mentioned, others were found in Mauretania⁸ and in Athens.⁹

¹Pliny, N.H. 36, 194.

²Dessau, Inscr. Lat. 1, 1224 b: Mavortii. | Q. Flavio Maesio Egnatio Lolliano | c.v., q.k., praetori urbano, auguri publico populi Romani Quiritium, cons. | albei Tiberis et cloacarum, cons. operum | publicum, cons. aquarum, cons. Camp. | comiti Flaviali, comiti primi | ordinis et proconsuli provinciae Africae | regio clivi vitriari sive vici turari | patrono dignissimo.

³Itin. Ant.: de Italia in Gallias. Item a Mediolano per Alpes Graias. 345, 2: Vitricium. Cod. vitritium C, vitridium J. L. N. XX R. cf. 347, 5. Item a Mediolana per Alpes Penninas. 351, 2: Vitricio. " Cod. vitritio C, vitracio o q, vitricioia P." ()

⁴Graesse, Orbis Latinus, ed. 2, 317.

⁵Pliny, N.H. 36, 194.

⁶Strabo, 4, 5, 3: καὶ ὑαλὰ σκεύη καὶ ἄλλος ῥῶπος τοιοῦτος.

⁷C I L XIII, 1, 1, 2000.

⁸C I L VIII 9430

⁹I G III 3436.

G. Evidence for the Importance of the Trade

In Greek and Latin there is no reference to the manufacture of glass in Greece with the exception of the glass-maker at Athens in Christian times.¹ As a foreign product, its nature was not sufficiently understood to prevent it from being confused with other substances. At first it was a rarity in Greece, and its value among other peoples is shown by its classification with precious metals and its use by those of high rank. The author of the book of Job² in praising wisdom says that "gold and glass cannot equal it," and classes glass with gold, silver, onyx, sapphire, coral, crystal, topaz, and rubies. Aristophanes³ speaks of the use of glass and gold cups at the Persian court. Glass had its place at the banquet of Ptolemy Philadelphus.⁴ In Epinicus⁵ King Seleucus is represented as drinking from a goblet of molten stone, i. e., glass. However, as early as the fifth century, B.C., glass was sufficiently familiar to be used as a standard of comparison for transparent objects (see above page 50). In the fourth century Pausias painted a figure drinking out of a cup of highly transparent glass.⁶

Yet it was not until the beginning of the Roman empire that we know much about glass. Strabo⁷ gives the first detailed

¹See above, p. 81.

²Job, 28, 17: οὐκ ἴσωθήσεται αὐτῇ χρυσίον καὶ ὕαλος.

³Ach. 94

⁴Athen. 5, 199 F.

⁵Athen. 10, 432 C.

⁶Paus. 2, 27, 3: γέγραπται δὲ ἐν ταῦθα καὶ Μέθης, Πανσίου καὶ τοῦτο ἔργον, ἔξ ὑαλίνης φιάλης πίνουσα. ὕδασι δὲ καὶ ἐν τῇ γραφῇ φιάλην τε ὑαλοῦ καὶ δὲ αὐτῆς γυναικὸς πρόσωπον.

⁷Strabo, 16, 758.

information about its manufacture in Egypt, Rome and Gaul. Then comes Pliny's¹ history of glass, which is the only one in antiquity with the exception of portions of Isidor's Origines² which closely follow the Natural History. Pliny not only tells of the traditional origin, the methods and places of manufacture, but he also describes valuable imported pieces. Since the Romans had their own factories, it is not strange to find the poets of the first and following centuries frequently mentioning glass. The adjective also was employed very often to express transparency, brightness, clearness, and possibly greenness.³

Even though glass became very common and cheap,⁴ there were still objects of glass which could be classed with the precious metals. Many of these seem to have been imported, especially from Egypt. Mention has already been made of the use of glass by the Egyptians in trading with the West Africans and peoples about the Red Sea. But since Rome herself produced quantities of excellent glass, that imported was probably only of exceptionally fine workmanship. The church naturally condemned such luxuries.⁵ The importance of the industry was sufficient to induce the Roman government

¹N. H. 36, 190 ff.

²Orig. 16, 16.

³Blümner, Farbenbezeichnungen bei den röm. Dichtern, 217 ff.

⁴Strabo, 16, 758; Petron, 50: ignoscetis mihi, quod dixero: ego malo mihi vitrea, certe non olunt. Quod si non frangerentur, mallet mihi quam aurum; nunc autem vilia sunt. Treb. Poll. Gallien. 17, 5: bibit in aureis semper poculis aspernatus vitrum, cum diceret, nil esse communius.

⁵Clemens Alex. Paedag. 2, 3, 35; 2, 4, 39.

to raise revenues by levying a duty on imported wares,¹ and to grant the workers in glass, as artists who deserved a special consideration, certain exemptions.²

¹Vopisc. Aurelian. 45. Lamprid. Alexander Severus, 24: bracariorum linteonum vitrariorum pellionum claustrariorum argentariorum aurificum et ceterarum artium vectigal pulcherrimum instituit ex eoque thermas et quas ipse fundaverat et superiores populi usibus exhiberi.

²Cod. Theod. XIII, 4, 2. Cod. Just. X, 66, 1.

BIBLIOGRAPHY

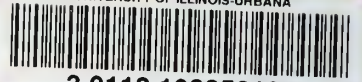
This bibliography does not include the editions of the Greek and Latin authors, lexica, etymologica and collections of inscriptions and papyri, for these are in each case the well known standard works. Modern writers upon the general history and philology of ancient glass are not numerous. The following are the principal works which have been used in the preparation of this thesis. The titles of publications which only incidentally touch upon aspects of the present study are given fully wherever cited in foot-notes, and need not be repeated here.

- Blümner, H., Technologie und Terminologie der Gewerbe Künste bei Griechen und Römern, IV, Leipzig, 1887.
 Glas in Pauly-Wissowa, VII, 1, Stuttgart, 1910, 1382 ff.
- Friedrich, C., An extensive review of Froehner's La Verrerie Antique in Jahrbücher des Vereins von Altertumsfreunden im Rheinlande, LXXIV, Bonn, 1882, 164 ff.
- Froehner, W., La Verrerie Antique, Le Pecq, 1879.
- Helbig, W., Das Homerische Epos, ed. 2, Leipzig, 1887.
- Kisa, A., Das Glas im Altertume, I - III, Leipzig, 1908.
- Lepsius, P., Die Metalle in den ägyptischen Inscriften in Abhandlungen der königlichen Akademie der Wissenschaften zu Berlin, Berlin, 1871, 129 ff.
- Morin-Jean, Vitrum in Daremberg et Saglio, Dictionnaire des Antiquités Grecques et Romaines, V, Paris, 1877, 1.
- Salmasius, C., Plinianae Exercitationes in Caii Julii Solini Polyhistoria, Utrecht, 1689.
- Wallace-Dunlop, M. A., Glass in the Old World, London, 1893.

VITA

Mary Luella Trowbridge was born near Green Valley, Illinois, February 4, 1894. In 1911 she graduated from Delavan High School; during the year 1911-1912 she attended Bradley Polytechnic Institute; from 1912-1916 she studied at the University of Illinois. In 1915 she was elected to Phi Beta Kappa and received the A. B. degree; the following year she was a Scholar in Classics and received the A. M. degree. In the second semester of the year 1916-1917 she went to Wasatch Academy, Mt. Pleasant, Utah, where she taught Latin and German for two years and was also assistant principal for the last year. During the summer of 1917 she did graduate work at the University of Wisconsin and during the summer of 1918 at the University of California. In the second term of the year 1918-1919 she returned to the University of Illinois, where she held a Fellowship in Classics in 1919-1920. During 1920-1921 she studied at the School of Classical Studies of the American Academy in Rome, and in September of the year 1921 she returned to the University of Illinois as a Fellow in Classics.

UNIVERSITY OF ILLINOIS-URBANA



3 0112 108856128